

The University of Chicago

DEVONIAN SUBSURFACE STRATA IN WESTERN KENTUCKY

A DISSERTATION SUBMITTED TO THE
FACULTY OF THE DIVISION OF THE
PHYSICAL SCIENCES IN CANDIDACY FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF GEOLOGY AND PALEONTOLOGY

1940

By

LOUISE BARTON FREEMAN

Private Edition, Distributed by
THE UNIVERSITY OF CHICAGO LIBRARIES
CHICAGO, ILLINOIS

Reprinted from
THE BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
Vol. 25, No. 4, April, 1941

The University of Chicago

DEVONIAN SUBSURFACE STRATA IN WESTERN KENTUCKY

A DISSERTATION SUBMITTED TO THE
FACULTY OF THE DIVISION OF THE
PHYSICAL SCIENCES IN CANDIDACY FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF GEOLOGY AND PALEONTOLOGY

1940

By

LOUISE BARTON FREEMAN

Private Edition, Distributed by
THE UNIVERSITY OF CHICAGO LIBRARIES
CHICAGO, ILLINOIS

Reprinted from
THE BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
Vol. 25, No. 4, April, 1941



DEVONIAN SUBSURFACE STRATA IN WESTERN
KENTUCKY

BY

LOUISE BARTON FREEMAN

Reprinted for private circulation from
THE BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
Vol. 25, No. 4, April, 1941

DEVONIAN SUBSURFACE STRATA IN WESTERN KENTUCKY¹

LOUISE BARTON FREEMAN²

Lexington, Kentucky

ABSTRACT

An attempt has been made to correlate the subsurface Devonian and Silurian strata in the western Kentucky basin with equivalent beds in the generally distant outcrops. Samples from about forty wells were studied, zoned on the basis of general lithology and insoluble residues, and a tentative correlation of these zones with the outcrop material suggested. The formations recognized at the surface in southern Illinois can be traced into the subsurface in western Kentucky.

The absence of the Decatur and upper Brownsport of the Tennessee Silurian from the sections high on the flank of the Cincinnati arch, and their presence on the west side of the basin indicates some post-middle Silurian and pre-Devonian uplift and erosion. The Kentucky Lower and lower Middle Devonian strata may represent the seaward facies of the Arkansas and Texas novaculites as thickening toward the southwest suggests that the source of the thick cherts and dolomites was in that direction.

Post-Hamilton warping of the basin, perhaps as a result of relative east-west uplift occasioned by movement of the Nashville dome, served to cut off the southern end of the syncline. This resulted in the preservation of a complete section of Lower and Middle Devonian in the deepest part, and the stripping of the Hamilton and most of the Onondaga from the east, south, and west sides. All or nearly all of the Devonian sediments were removed from the region high on the Cincinnati arch side of the basin, from Hardin County south to Barren County, before deposition of the Chattanooga shale.

INTRODUCTION

PURPOSE

The purpose of this investigation is to correlate the subsurface Devonian strata in the western Kentucky basin with the equivalent beds in the generally distant outcrops. So far as possible the work has been carried on through study of well samples, on the basis of both general lithology and insoluble residues. This paper covers the progress to date on this study, and includes subsurface correlation by zones supplemented by tentative correlations of these zones with outcrop material. As new information becomes available through future drilling the suggested correlations may be substantiated or altered.

LOCATION OF AREA

The region covered in greatest detail by this study is that part of Kentucky west of the Devonian outcrop on the western flank of the

¹ Manuscript received, November 8, 1940.

² The writer wishes to thank the Kentucky State Department of Mines and Minerals, especially D. J. Jones, who suggested the problem and who was responsible for the collection of most of the well samples, and Miss Lena Palmer who was of inestimable aid in the preparation of the samples for study. Such subsurface studies are only possible through the coöperation of the operators, drillers, and geologists working in this area, and the writer wishes to express appreciation to them for their assistance. Special thanks are due Carey Croneis for assistance in the collection of outcrop samples in Missouri, and for his criticism of and helpful advice in the preparation of the manuscript.

Cincinnati arch, and east of the Tennessee River. Inasmuch as the limits of the basin are not determined by political boundaries, it has been necessary to obtain much information from neighboring states, especially southeastern Missouri, southwestern Illinois, southern Indiana, and western Tennessee.

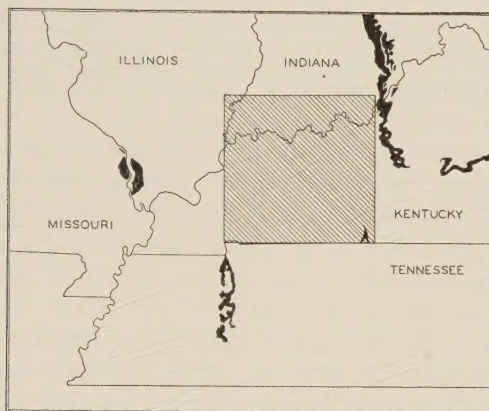


FIG. 1.—Map showing area included in this study and its relation to areas of Devonian outcrop.

STRATIGRAPHY OF DEVONIAN OUTCROP

LOWER DEVONIAN

The Lower Devonian does not crop out in Kentucky, but is represented in western Tennessee, southwestern Illinois, and southeastern Missouri.

TENNESSEE

The section as exposed in the valley of the Tennessee River is described by Dunbar (11)³ as follows.

HELDERBERGIAN

Rockhouse shale.—This formation was named by Dunbar (10: p. 736) and described as a southward-thickening wedge inserted between the Ross limestone above and the Silurian Decatur limestone below. The Rockhouse is

A glade-forming, calcareous shale of greenish gray color, interbedded with occasional thin bands of light gray, crystalline limestone. Toward the base of the shale, the bands of the limestone become thicker and closer set, so that the formation appears to grade into the underlying Decatur (11: p. 38).

The maximum thickness of the formation is 26 feet at its type exposure

³ Figures in parentheses refer to bibliography at end of article.

at Rockhouse, a hunters' clubhouse on Horse Creek, 5 miles northwest of Lowryville. The most characteristic fossils are *Anoplothea concava*, *Bilobites bilobus*, *Nucleospira concentrica*, *Rhipidomella oblata*, *Scyphocrinus* (*Camarocrinus*) *saffordi*, *Edriocrinus pocilliformis*, and *Pleurodictyum trifoliatum*.

Olive Hill formation.—This formation was named and described by Dunbar (10: p. 738) from an exposure in a bluff on Indian Creek at Olive Hill, Hardin County. It consists of three distinct lithologic units. In ascending order, these are the Ross limestone, the Bear Branch, and the Flat Gap members.

The Ross limestone member was defined by Foerste (14) and named from exposures on the Ross farm, near Sulphur Springs, Hardin County. It is impure, dark gray, siliceous and cherty limestone in thin layers, and is extremely hard, compact and cliff-forming. "The silica is so finely disseminated that it may not appear as chert even where the rocks analyze over 20 per cent SiO_2 " (11: p. 45). At the south the member contains thin bands of bluish chert at irregular intervals. The fresh rock is bluish gray, hard and dense, but with exposure it turns brown, the lime is leached, and a residue of insoluble silica remains as a soft porous shaly sandstone. The Ross limestone has a maximum thickness of 60 feet and is the most persistent member of the Olive Hill formation. The most conspicuous fossils are *Scyphocrinus* (*Camarocrinus*) root bulbs.

The Bear Branch member was named by Dunbar (10: p. 738) from an exposure on Bear Branch, about 2 miles southeast of Olive Hill, Hardin County, where it forms a bluff showing 20 feet of low-grade ore resembling the Clinton type. It is impure limestone, coarse-grained, with oölitic hematite in the lower part, and thickly stratified, rather pure, cross-bedded limestone with streaks of oölitic iron ore in the upper part. The member, whose maximum thickness is 45 feet, is but sparingly fossiliferous, the most characteristic species being *Anastrophia verneuili*, *Schellwienella woolworthana*, *Rhipidomella oblata*, *Spirifer cyclopterus*, *S. perlamellosus*, and *Favosites helderbergiae*. Toward the south the Bear Branch member grades into the Pyburn limestone, the lower part of which is thin-bedded, dirty, impure, and cherty, with sporadic bands of chert 2-10 inches thick. The upper part is more heavy-bedded than the lower and lithologically it closely resembles the Ross limestone.

The Flat Gap member is a heavy-bedded, coarsely crystalline or granular limestone, white or pinkish in color, and sparingly fossiliferous. The most characteristic fossils are *Rhipidomella oblata*, *Spirifer cyclopterus*, *Delthyris perlamellosa*, and *Dalmanites pleuroptyx*.

Birdsong formation.—Dunbar (10: p. 741) described the Birdsong formation and named it from its typical exposures along the valley of Birdsong Creek in Benton County. He states (11: p. 55) that Foerste tentatively regarded this formation as a correlative of the Pyburn, but that his own studies have indicated that this correlation is erroneous.

The Birdsong formation begins with a few feet (8-10) of heavy-bedded, rather pure, coarsely crystalline limestone. Above this it passes into interbedded bluish shale and thin bands of crystalline limestone and then into softer, calcareous, blue shale, constituting the upper half to three-fourths of the formation. Harder calcareous laminae and thin bands or lentils of limestone occur throughout the shale. When fresh the latter is partly indurated by its large percentage of calcium carbonate, but it weathers into bluish clay and a rubble of small limy fragments forming barren hillside slopes or "glades," . . . (11: p. 55).

The Birdsong is 35-65 feet thick and goes under cover toward the north without any marked decrease in thickness. It thins toward the south, however, and in some sections is entirely absent. Erosion has reduced its thickness toward the east where in places there remain only about 10 feet of the lower calcareous part overlain by the Hardin sandstone.

The Birdsong is highly fossiliferous with brachiopods dominant except in one zone which is replete with bryozoans. The most characteristic fossils are *Dalmanites pleuroptyx*, *D. retusus*, *Phacops logani*, *Anastrophia verneuili*, *Anoplothea concava*, *Bilobites varicus*, *Cyrtina dalmani*, *Platyorthis planoconvexa*, *Gypidula coeymanensis*, *Leptostrophia becki*, *Nucleospira ventricosa*, *Orthostrophia strophomenoides*, *Spirifer cyclopterus*, *S. macropleurus*, *S. perlamellosus*, *Edriocrinus pocilliformis*, and *Scyphocrinus* (*Camarocrinus*) *mutabilis*.

Decaturville chert.—This formation was defined by Dunbar (10: p. 744) and named from typical exposures near Decaturville, Decatur County. It is only about 6 feet thick, but it is widely distributed. The Decaturville consists of yellowish to gray or slate-colored chert disconformably overlying the Birdsong. The upper few inches are very porous and extremely fossiliferous; the lower part is lighter-colored and thinner-bedded. The fossils are preserved as natural molds and casts or pseudomorphs, and are remarkably large. The most characteristic forms are *Anoplothea concava*, *Platyorthis planoconvexa*, *Spirifer perlamellosus*, *Eatonia medialis*, *E. singularis*, *Rhipidomella oblata*, *Stropheodonta* (*Leptostrophia*) *becki*, and *Pleurodictyum lentulare*.

ORISKANIAN

Quall limestone.—This is the lower formation of the upper Oriskany in western Tennessee. It was named by Dunbar (10: p. 746) from its outcrop on the farm of Jim Quall in the valley of Dry Creek, a small stream entering the Tennessee River near Walnut Grove, Hardin County. Its total thickness does not exceed 10 feet. Dunbar (11: p. 69) states that

Where freshly exposed, the limestone is light gray in color, rather fine-grained, and disposed in layers from 18 to 24 inches thick. It appears slightly magnesian, and highly siliceous. Upon deep weathering it breaks down into a very porous rotten white and yellow chert and yellow clay, in which fossils abound as free pseudomorphs in silica.

The Quall limestone is present only locally, but its southward extension is greater than that of the overlying Harriman novaculite. Such fossils as *Spirifer arenosus*, *S. purchisoni*, and a large *Striatopora* indicate its Oriskany age.

Harriman novaculite.—This formation was named by Dunbar (10: p. 747) from exposures on Harriman Creek, Decatur County. It overlies the Quall and is in turn overlain by the lithologically similar Camden chert from which it is distinguished only by its fauna.

The Harriman chert or novaculite is nearly white on fresh exposure, but weathers to shades of yellow and buff. It is disposed in layers varying from a few inches to over a foot in thickness, and is very hard and brittle. Where exposed to weathering, it is thoroughly fractured into small angular fragments and in this condition so very closely resembles the Camden chert that only the fossils can be relied on to distinguish the two formations (11: p. 71).

The novaculite is 30–55 feet thick, the thickest sections being at the north. The Harriman disconformably laps over older formations and in places rests directly on middle Silurian strata. The most characteristic fossils are *Leptostrophia magniventra*, *Chenostrophia complanata*, *Plethorhyncha* cf. *barrandei*, *Rensselaeria ovoides*, *Spirifer purchisoni*, *S. arenosus*, *Meristella lata*, *Anoplothecca dichotoma*, and *Platyceras gebhardi*.

Dunbar's correlation of the Devonian in western Tennessee with the Devonian of the New York section is shown on the following chart.

ILLINOIS

The Devonian strata, exposed only in western Union and southwestern Jackson counties in Illinois, have been described by Bassett (1) and Savage (28, 29, 30).

HELDERBERGIAN

The Helderberg is represented by the Bailey limestone, described by Ulrich (35) in 1904 from an exposure at (the former) Bailey's Landing on the Mississippi River, Perry County, Missouri, a short distance above Red Rock Landing. The Bailey is best exposed along

— BREAK —		HARRIMAN CHERT		UPPER	ORISKANIAN	LOWER	DEVONIAN
BREAK QUALL LS.							
BREAK				BECRAFT			
BREAK							
DECATURVILLE CHERT				HELDERBERGIAN			
— BREAK —					COEYMANS- KEYSER		
OLIVE HILL	FLATGAP LS. BEAR BRANCH PYBURN LS. ROSS LS.			NIAGARAN			
	ROCKHOUSE SH.						
— GREAT BREAK —							
DECATUR LS.							

FIG. 2.—Generalized section of Lower Devonian in western Tennessee.

the Mississippi River below Grand Tower in Jackson County, Illinois. The limestone is thin-bedded, gray, earthy, or dolomitic, containing chert nodules commonly transformed to tripoli on exposure. In places it is 200 feet thick. Fossils are rare but those present indicate Helderbergian New Scotland affinities; a few exposures contain numerous *Scyphocrinus* (*Camarocrinus*) bulbs.

ORISKANIAN

Rocks of Oriskany age in Illinois consist of a lower thick-bedded chert formation, the Grassy Knob, which is 150 or more feet thick. This passes upward with gradual transition into a coarsely crystalline limestone, the Little Saline (Backbone), which is about 200 feet thick.

Grassy Knob chert.—This formation was described by Savage (30) from an outcrop on the west side of Grassy Knob, Jackson County, Illinois. It is a very rough-surfaced, hackly, thick-bedded, gray to reddish brown chert in layers 12–48 inches thick. The layers become thinner toward the top where they change to rather even-bedded, whitish, iron-stained layers 4–8 inches thick (1). Fossils are rare and are mainly *Anoplothecha flabellites*, *Orthotetes pandora* and *Spirifer purchisoni*. There is no apparent stratigraphic break between this formation and the underlying Bailey.

*Little Saline limestone.*⁴—This limestone is known only in the northwestern corner of Union County and the southwestern corner of Jackson County. Bassett has estimated its thickness at 230 feet. It consists of light gray, more or less crystalline, crinoidal limestone with much bedded chert in thin irregular bands. It contains several thick layers of coarsely crystalline white limestone similar to the Little Saline of southeastern Missouri. The chert is more porous than that of either the Grassy Knob below or the Clear Creek above, and contains molds of crinoid stems and bryozoan fragments.

The fossils are large and abundant only in the lower massive layers; they become smaller in size upward. The following forms suggest the Oriskanian age of this formation: *Beachia ovalis*, *B. suessansa*, *Leptostrophia magnifica*, *Plethorhynchia barrandei*, *Rensselaeria marylandica*, and *Spirifer arenosus*.

A marked erosional disconformity separates the Little Saline limestone from the overlying Clear Creek chert. The limestone thins to disappearance south and east; and where the Grassy Knob and Clear Creek cherts are thus brought in contact they are practically indistinguishable due to the almost total lack of fossils.

MISSOURI

The Devonian of southeastern Missouri is exposed in the Little Saline faulted area chiefly in Ste. Genevieve County. Weller and St.

⁴ Savage first described and named this formation the Backbone limestone from its exposure near the south end of Devil's Backbone Ridge, a short distance north of Grand Tower, Jackson County. *Amer. Jour. Sci.*, 4th Ser., Vol. 49 (1920), pp. 169–78. Later, however, he recognized its equivalency to the Little Saline, as described by Weller for the Missouri section, and he replaced his earlier name with the Little Saline limestone. *Amer. Jour. Sci.*, 5th Ser., Vol. 10 (1925), pp. 139–44.

Clair (38: p. 131) assign a thickness of about 640 feet to the Devonian strata which in this area all belong to the lower and middle divisions of the system.

HELDERBERGIAN

Bailey formation.—This formation, named by Ulrich (35: p. 110) is very much like the Bailey already described for Illinois, particularly the lower half of the 200 feet usually assigned to the Bailey in Missouri. Above this is 5–10 feet of

light gray, very granular crystalline limestone, and the overlying upper half of the formation consists mainly of chert that is rarely well exposed but produces conspicuous talus deposits on the hillsides. The chert is light colored and breaks into angular fragments. Much of it is dense but some is porous and contains the impressions of fossils (37: p. 128).

The upper part of the formation is more fossiliferous than the Bailey of Illinois, and the fossils in the main are silicified.

J. M. Weller (37: p. 128) suggests that the upper part of the Bailey might be equivalent to part at least of the Grassy Knob chert of Illinois. The lower part of the Bailey is less fossiliferous and is characterized by *Leptaena rhomboidalis*, pygidia of large *Dalmanites*, and many bulbous stem bases (*Camarocrinus*) of the crinoid *Scyphocrinus*.

Microscopic examination of hand specimens⁵ and of insoluble residues show the lower Bailey limestone to be white to light tan-gray, very coarsely crystalline, crinoidal and cherty with most of the chert as partial replacement of crinoid ossicles. The 5–10 feet of limestone in the middle of the formation is very fossiliferous, coarsely crystalline, granular, and gray with much green and some pink calcite. The upper portion of the Bailey is similar to the lower in its coarsely crystalline character but it contains much chert, some of which is dull white and some white mottled translucent and dull.

ORISKANIAN

Little Saline limestone.—The Bailey is succeeded in Ste. Genevieve County, Missouri, probably disconformably, by the Little Saline limestone which is about 100 feet thick. It was first described and named by Dake (9: p. 88), the name having been taken from an unpublished manuscript by Stuart Weller. Weller and St. Clair describe it as

a very pure, thickly bedded, more or less coarsely crystalline limestone, nearly white in color or with a slight pinkish tint, and is filled with fossils in its lower half. One bed towards the top is decidedly crinoidal, with great numbers of fragments of crinoid stems upon the weathered surfaces. At some iso-

⁵ Outcrop samples of the Devonian were collected from Ste. Genevieve County, Missouri, under the direction of Carey Croneis.

lated outcrops, where fossils are scarce, it is difficult to distinguish some portions of this limestone from certain beds of the Kimmswick limestone, but usually sufficient fossil evidence can be secured to differentiate the two formations. In the upper half of the formation there are two beds of dense, hard, close-textured, nearly white limestone, with great numbers of a Bryozoan resembling those forms which have been described as *Lichenalia*. The first of these beds, ten feet in thickness, lies immediately above the more coarsely crystalline, highly fossiliferous beds, the other being at the extreme summit of the formation, about eight feet thick. Between these two *Lichenalia* beds the rock is coarsely crystalline, similar to that in the lower half of the formation, but much less fossiliferous (38: pp. 137-38).

The formation is apparently entirely free from chert, and some beds have the characteristics of a good marble.

Microscopic examination of the Little Saline reveals it to be very coarsely crystalline and crinoidal with green calcite here and there and streaks of more finely crystalline pink limestone. A few large rounded and frosted quartz grains appear in the insoluble residues.

The most abundant fossils are *Spirifer murchisoni*, *S. arenosus*, *Rensselaeria ovoides*, *Plethorhyncha barrandei*, *Diaphorostoma ventricosum*, *Platyceras gebhardi*, *Anoplia nucleolata*, *Anoplothea flabellites*, *Beachia suessansa*, *Chonostrophia complanata*, *Eatonia peculiaris*, *Leptostrophia magnifica*, *L. magniventra*, *Megalanteris ovalis*, *Metaplasia pyxidata*, and *Rhipidomella muscula*. This fauna, according to Butts (4: p. 401), is typical for the Oriskany fauna of New York, whereas Weller and St. Clair (38: p. 141) consider it a transition fauna between the Lower Devonian Oriskany and the Middle Devonian Onondaga faunas.

CORRELATION

HELDERBERGIAN

There is no equivalent to the Rockhouse shale of Tennessee in the sections of Illinois and Missouri. Dunbar (11: p. 43) regards its position as being close to the Siluro-Devonian boundary line because of the predominance in the fauna of Devonian species, accompanied by a number of Silurian forms and primitive expressions of such species as *Pleurodictyum trifoliatum* and *Rhipidomella preoblata*. Due to the thick overlying Helderbergian section he considers this fauna to be about the same age as the Keyser formation of Maryland, but he suggests that there was no direct communication between the Mississippian embayment and the Appalachian trough.

The Olive Hill formation is very closely related to the succeeding Birdsong which is more exactly the equivalent of the New Scotland. Since the Olive Hill is considerably older than the Birdsong in its faunal development Dunbar considers it the correlative of the upper

Coeymans. *Scyphocrinus* (*Camarocrinus*) bases, which are so characteristic of the Tennessee Helderberg, are also common in the Bailey of Missouri and Illinois, and in the Haragon shale of Oklahoma. The Decaturville chert is correlated by Dunbar (11: p. 68) with the lower part of the Becraft of New York on the basis of the considerable dis-

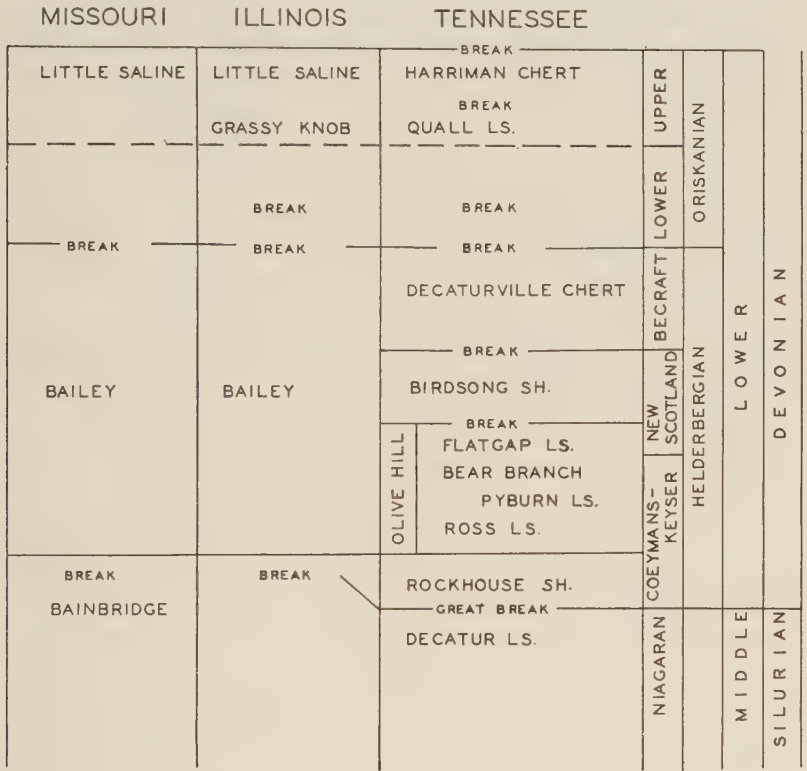


FIG. 3.—Generalized sections of Lower Devonian in western Tennessee, southwestern Illinois and southeastern Missouri.

conformity at its base, in spite of the lack of a definite Becraft facies in the fauna. This would make the chert equivalent to the upper Bailey of Illinois.

ORISKANIAN

Savage (30) suggests that the Quall limestone of Tennessee, Dunbar's lower upper Oriskany, is part of the Grassy Knob chert, and that the upper, more fossiliferous Harriman chert, which contains a large Oriskany fauna, probably represents a part of the Little Saline limestone of Missouri and Illinois.

MIDDLE DEVONIAN

TENNESSEE

The Middle Devonian exposed in western Tennessee consists of two formations, the Camden chert and the Pegram limestone, the former beds resulting from "an earlier invasion from the southwest, the latter representing a brief incursion of the Onondagan coral fauna which apparently spread southward into Tennessee from the Kentucky-Ohio basin where it was so well developed at the Falls of the Ohio" (11: p. 77).

ONONDAGAN

Camden chert.—The Camden was named by Safford and Schuchert (26) from an exposure at Camden, Benton County. Dunbar (10) restricted the name to the upper 200 feet of the beds to which it had formerly been applied, and subdivided the lower part into the Harriman, Quall, and Decaturville. He described the Camden as follows. It is a white to buff-yellow, brittle novaculite. Although flinty hard and very resistant to decomposition, the ultimate effect of weathering is to reduce the rock to finely powdered silica mixed with more or less clay, the latter being an insoluble impurity in the novaculite (11: p. 79).

The novaculite breaks with an irregular fracture into sharp-edged fragments, and natural outcrops appear only as a loose rubble of rough, angular pieces of chert. The bedding is rarely regular for more than a few yards, and the strata display considerable crumpling in spite of the fact that the overlying and underlying beds show no deformation. These typical characters are maintained in every exposed section except that at the "whirl" on Buffalo River, where there is a series of interbedded limestones and cherts directly overlain by the Pegram limestone. At this locality both the fauna and lithology are different from those at other exposures, and in all other sections the Camden is disconformably overlain by much later strata of late Devonian or even Cretaceous age. Dunbar (11: pp. 80-81) suggests that this is younger Camden which was protected by the Pegram while its correlatives were being eroded during later Middle Devonian time. The absence of many of the typical Camden fossils and the presence of *Spirifer macrothyris*, an Onondagan species, supports his belief that the beds on Buffalo River should be regarded as strata transitional between the true Camden and the Pegram limestone.

Dunbar gives a maximum exposed thickness of 164 feet for the Camden on Cypress Creek. Where the Camden rests on the Harriman novaculite a disconformable contact is not discernible although it is inferred from the faunal break. In many places, however, the Camden

rests on older Devonian, the underlying strata in some places being as old as the Bryozoan layer of the Birdsong. The characteristic fossils are *Anoplia nucleata*, *Chonostrophia reversa*, *Pentagonia unisulcata*, *Leptocoelia flabellites*, *Chonetes hudsonicus camdenensis*, *Spirifer hemicyclus*, *S. worthenanus*, *Eodevonaria arcuata*, *Amphigenia curta*, and *Atrypa reticularis*. The following species, however, are more characteristic of this formation as it is exposed in the Buffalo River area: *Rhipidomella* cf. *penelope*, *Leptaena rhomboidalis*, *Stropheodonta* cf. *blainvillei*, *S.* cf. *hemispherica*, *Schuchertella pandora*, *Chonostrophia reversa*, *Eatonia peculiaris*, *Oriskania condoni*, *Amphigenia curta*, *Leptocoelia flabellites*, *Spirifer macrothyris*, *S. hemiculus*, and *Meristella lentiformis*.

Pegram limestone.—Foerste (13: pp. 400-25) described and named this formation from exposures at Pegram, Cheatham County. Later Pohl (24) in an abstract divided the Pegram into the Sellersburg limestone above and the Jeffersonville below, and suggested discarding the name Pegram. The name Pegram is being used in this report as Pohl's complete evidence for this change is not available. It is a rather pure, heavy-bedded, light gray limestone which reaches its maximum thickness of 12 feet in the Pegram exposures. As mentioned above, in the Buffalo River area it overlies Camden, but at Pegram it rests on Middle Silurian limestones. The characteristic fossils are *Stropheodonta demissa*, *S. perplana*, *Rhipidomella penelope*, *Nucleospira concinna*, the diagnostic Onondaga blastoid *Nucleocrinus verneuilli*, and the corals *Heliophyllum*, *Blothrophyllum*, *Cystiphyllum*, *Cyathophyllum*, and *Cladopora*, which indicate its equivalency to the Jeffersonville.

Foerste (13: p. 425) described another Pegram section in the Harpeth River region where the Silurian Louisville limestone is overlain by the limestone thickening to the west. The upper 6-12 inches are earthy, and contain small black pebbles similar to those found in the top of the Devonian in southern Indiana and Kentucky. This darker layer contains *Camarotoechia carolina*, *Tropidoleptus carinatus* and *Spirifer pennatus*, and represents the Sellersburg equivalent.

HAMILTON

The Hamilton group is represented in western Tennessee only by the few feet of Sellersburg which Pohl and Foerste (13: p. 425) identified in the top of the Pegram limestone.

ILLINOIS

ONONDAGAN

The Middle Devonian is represented in Illinois by both the Onon-

daga and the Hamilton groups. At Hicks Dome in Hardin County, southeastern Illinois, the Devonian is exposed near the crest of an anticlinal structure. The base of the Onondaga is not readily observed but its presence is demonstrated by the appearance of such fossils as *Amphigenia curta*, *Spirifer duodenarius*, *S. varicosus*, and *Nucleocrinus verneuili*. The Onondaga is overlain by an undetermined thickness of Hamilton limestone and chert containing *Chonetes coronatus*, *Meristella haskinsi*, *Spirifer audaculus*, and *S. iowensis*.

In southwestern Illinois, Alexander, Jackson, and Union counties, the Onondaga is reported to include three divisions, in ascending order: Clear Creek chert, Dutch Creek sandstone, and Grand Tower limestone. The Hamilton is represented by the Misenheimer shale and the Lingle limestone.

ONONDAGAN

Clear Creek chert.—Worthen (41: pp. 126-29) as early as 1860 gave this name to a series of fossiliferous, siliceous limestones exposed on Clear Creek, Union County, Illinois, which he stated were Helderbergian and Oriskanian in age. Dunbar (11: pp. 68-69, 80, 91) later demonstrated the correlation of the Clear Creek with the Camden chert of Tennessee, which he referred to the Onondaga. Savage (20: pp. 160-78) and Pohl (25: pp. 54-63) suggested an equivalency to the Esopus and Schoharie grit of New York, but later Savage (20) agreed with Dunbar in its Onondaga age. The United States Geological Survey (36) classifies the Clear Creek limestone as of Oriskany and Onondaga age.

The Clear Creek, as described by Bassett (1), is commonly thin-bedded, slightly iron-stained, gray chert. In places the upper part is made up of alternating crystalline limestones and chert layers, commonly novaculitic, whereas the lower part is commonly made up of layers of chert 10-12 inches thick. In the northwest outcrop area this formation rests disconformably on the Little Saline limestone, but at the southwest where the Little Saline disappears, the chert is hard to distinguish from the underlying Grassy Knob. Savage (20) has estimated the thickness of the Clear Creek chert to exceed 300 feet, but J. M. Weller (37: p. 120) suggests that it may be considerably more. Weller also states that "this formation is believed to overlie the Backbone (Little Saline) limestone conformably."

Silicified fossils and molds of fossils are common, especially in the upper part. The most characteristic forms demonstrating Onondagan age are *Chonostrophia reversa*, *Spirifer* cf. *divaricatus*, *S. duodenarius*, and *Dalmanites calypso*.

Dutch Creek sandstone.—Savage described and named this formation from exposures on Dutch Creek in southwestern Union County, Illinois. It is a reworked sand of the St. Peter type, commonly stained brown with iron oxide. The beds are massive and hard, and vary in thickness from a few inches to 30 feet. The Dutch Creek contains numerous molds of fossils, the most characteristic forms being *Pleurodictyam problematicum*, several species of *Zaphrentis*, *Leptostrophia perplana*, *Rhipidomella* cf. *penelope*, *Amphigenia curta*, *Spirifer duodendarius*, *S. macrothyris*, and a species of *Odontocephalus*. The sandstone rests conformably on the Clear Creek below and grades into the Grand Tower above.

Grand Tower limestone.—Keyes in 1894 (17: pp. 30, 42) first gave this name to the Onondaga and Oriskany limestones of southeastern Missouri. In 1910 Savage (27) limited the name Grand Tower to those limestones representing the western equivalent of the New York Onondaga limestone. These strata have a thickness of approximately 125 feet at Backbone Ridge, north of Grand Tower in Jackson County, Illinois. They are rather pure granular to sub-crystalline limestones, light to dark gray in color, and thickly stratified, locally with some chert. The most significant fossils for correlation are *Odontocephalus aegeria*, *Phacops cristata*, *Proetus crassimarginatus*, *Platyceras dumosum*, *Conocardium cuneus*, *Paracyclas elliptica*, *Meristella nasuta*, *Nucleospira concinna*, *Pentamerella arata*, *Spirifer acuminatus*, *S. duodenarius*, *S. macrothyris*, *S. raricostus*, *S. varicosus*.

MARCELLUS AND HAMILTON

Misenheimer shale.—Savage (28: pp. 169–78) described the Misenheimer and named it from exposures in Misenheimer Creek, Union County, Illinois.

It consists of a maximum thickness of about 30 feet of very silty and massively bedded shale which weathers to a drab color and locally resembles the Springville shale of lower Mississippian age (37: p. 129).

The shale in places overlaps the Grand Tower, the Dutch Creek sandstone, and the Clear Creek chert; in such places the basal part is a greatly disturbed dark shale containing numerous shells of *Leiorhynchus limitare*. Savage (29) states that the shale corresponds both in stratigraphic position and faunal content with the Marcellus shale of New York. Weller (37: p. 129) agrees in general with this statement but points out also that the Misenheimer in part grades laterally northward into the Lingle limestone of Hamilton age.

Lingle limestone.—Savage (28: pp. 171–76) described and named this formation from exposures along a branch of Lingle Creek, Union

County, Illinois, where it conformably overlies the Misenheimer shale. The Lingle consists of dark gray to nearly black, thinly stratified limestone, which is in places very impure and silty. The thickness of the Lingle limestone plus the Misenheimer shale is 88–100 feet. That it is Hamilton in age is suggested by the following fossils: *Microcyclus discus*, *Chonetes pusillus*, *C. coronatus*, *Tropidoleptus carinatus*, *Vitulina pustulosa*, *Athyris spiriferoides*, *Spirifer audaculus*, *S. fornacula*, *S. granulosus*, *S. pennatus*.

MISSOURI

Both the Onondaga and the Hamilton groups are represented in the Middle Devonian of southeastern Missouri, where the Onondaga, although consisting of three formations in southwestern Illinois, is represented solely by the Grand Tower limestone. The Marcellus and Hamilton equivalents are the Beauvais sandstone below and the St. Laurent limestone above.

ONONDAGAN

Grand Tower limestone.—The formation is limestone throughout although somewhat variable in lithologic character. Weller and St. Clair (38: p. 143) give the following typical section, which is exposed along the east bank of Little Saline Creek, Ste. Genevieve County.

	<i>Feet</i>
11. Limestone, a white finely crystalline marble; as exposed on the surface more or less interruptedly, the beds are thin and some of them include numerous grains of quartz sand scattered more or less regularly through the limestone matrix.	15
10. Talus covered interval.	40
9. Limestone, fine-grained, granular, hard and tough, bluish upon freshly fractured surfaces, becoming brown with weathering. Rather thinly bedded. Fossils abundant in some beds, the brachiopod genus <i>Schizophoria</i> the most common form.	55
8. Limestone, in thin even beds, nearly pure crystalline, white to buff in color. Fossils very scarce.	85
7. Limestone, light colored, mostly nearly white, in rather heavy beds, the texture variable, from granular to dense. Filled with fossil corals in great variety.	25
6. Limestone, coarsely crystalline, very pure and nearly white, similar to the Little Saline limestone in texture and appearance. Weathered surface rough, with numerous fragmental crinoid stems. The basal part contains corals in abundance.	25
5. Limestone, dense, hard, compact, and brittle, with numerous irregular chert concretions. No fossils observed.	12

It will be observed that the Grand Tower, which is 250 feet thick in Ste. Genevieve County, is sandy in its *upper* part, whereas the section at the type locality in Illinois, where it is only 125 feet thick, contains sandy *lower* beds in the zone of gradation into the underlying Dutch Creek sandstone.

A microlithologic study of the Grand Tower shows it to be some-

what arenaceous throughout but with an increase of coarse sand upward toward the Beauvais and an increase of silty sand toward the base. Descriptions of hand specimens are as follows.

6. Limestone (near base of Beauvais sandstone), brown, arenaceous with much sand evenly distributed through it. Sand grains are large, rounded and frosted, and show no secondary enlargement. They are well sorted as to size with no fine silty sand such as occurs below
5. Limestone, white, with numerous large rounded and frosted sand grains scattered through it. Limestone shows a little superficial pink stain
4. Limestone, not so coarsely crystalline as above and with more pink color. There are only a few large rounded and frosted sand grains, but some very fine sand appears in residue
3. Limestone, slightly dolomitic, dark brown, finely crystalline to dense, with a little fine rounded sand enclosed
2. Limestone, very coarsely crystalline and pink. Residue shows some very fine sand with rare large rounded and frosted grains
1. Limestone, more finely crystalline and pink than above, with much more fine sand and still showing rare large rounded and frosted grains

MARCELLUS AND HAMILTON

Beauvais sandstone.—Dake (9: p. 88) described this formation, taking the name from an unpublished manuscript by Stuart Weller. The Beauvais is exposed only in the Little Saline fault area of Ste. Genevieve County, where it attains a thickness of less than 50 feet. It consists of massive beds of reworked St. Peter type; it is very coarse grained and white, or stained with iron oxide. Fossils are very poorly preserved, but the rare *Newberryi claypolei* has long been recognized. In 1931 Croneis and Hoffman (7) collected and listed a considerable fauna from the Beauvais sandstone, and demonstrated its similarity in stratigraphic position and faunal content to the Marcellus of New York. It is conformably transitional between the underlying Grand Tower and the overlying St. Laurent limestone.

Microlithologic examination shows that the sand content of the Grand Tower increases until it grades insensibly into the overlying Beauvais, and that the Beauvais becomes more calcareous toward the top. Some layers resemble the upper layers of the Grand Tower except that the sand grains are not so evenly distributed in the Beauvais and the sand itself is very poorly sorted as to grain size. There is a dolomite layer at the top, pale pink to yellow in color, finely crystalline with an uneven distribution of large sand grains, and flaggy on outcrop. The sand in the middle part of the section ranges from fine to very coarse and practically all grains show secondary crystal growth, the crystals being almost complete in many instances.

St. Laurent limestone.—This formation was first described by Dake (9: pp. 88, 175) and named the St. Lorenz. Wilson (39: p. 51) later referred to this limestone as the St. Laurent, having taken the name from an unpublished manuscript by Stuart Weller. The type

exposure is along St. Laurent Creek about 3 miles south of St. Marys, Ste. Genevieve County. J. M. Weller described the St. Laurent as follows.

This formation which includes about 275 feet of strata at its type locality, is extremely variable in lithology and includes various types of limestone that are mainly thin-bedded, fine-grained, and gray to bluish in color. Several layers in various parts of the St. Laurent are more or less sandy and there are several beds of pure sandstone composed of grains probably reworked from the St. Peter or some older formation. Limestone conglomerate also occurs and some chert is present although this is commonly found in the residuum derived from the formation and is seldom observed in place. Fossils are rare or absent in most of the St. Laurent strata. It is improbable that any important break in sedimentation separated this formation from the underlying Beauvais sandstone (37: p. 129).

The most characteristic fossils are *Pterinea flabella*, *Chonetes coronatus*, *Eunella lincklaeni*, *Cyrtina hamiltonensis*, *Spirifer audaculus*, *S. macronatus*, and *Cystiphyllum americanum*.

Microolithologic examination of the St. Laurent shows that the limestone in general is more finely crystalline and dense than the Grand Tower. Some layers are light gray, almost lithographic limestone and some are arenaceous with poorly sorted grains of rounded and frosted quartz. There are a few beds of white sandstone, with the grains showing a wide size range and a previously rounded and frosted surface texture. The sandstone is closely cemented by secondary crystal growth, which feature is better exhibited than in the Beauvais sandstone below. Near the base there is a conglomeratic layer of limestone containing very finely crystalline quartz, some large rounded and frosted grains, small round pebbles of brown limestone similar to some of the Grand Tower and pebbles of very finely crystalline light gray limestone, lighter in color than the matrix.

SOUTHERN INDIANA

Both the Onondaga and Hamilton are represented in southern Indiana, the Onondaga by the Pendleton sandstone and the Jeffersonville limestone, with the Geneva in the northern part of the area, and the Hamilton by the Sellersburg limestone.

Pendleton sandstone.—Cox (6: p. 62) described and named this sandstone from its exposures at Pendleton, Madison County, Indiana. He stated that according to James Hall it contained Schoharie fossils and assigned it to the Corniferous. Kindle (19: pp. 558-61) described the Pendleton as being the stratigraphic equivalent of the Jeffersonville limestone, and Cumings (8: p. 464) called it Schoharie. Logan (21) described it as being locally conglomeratic and a true basal sand-

stone; he doubted that it was the western representative of the Schoharie grit, but placed it below the Jeffersonville in his tables. It consists of 15 feet of heavy-bedded, soft, white sand, the upper part of which is fossiliferous. The characteristic fossils include *Reticularia fimbriata*, *Martinia subumbona*, *Pentamerella arata*, *Atrypa reticularis*, *Tentaculites dextithea*, *Bellerophon curvilineatus*, *Conocardium trigonale*, *Proetus curvimarginatus*, *P. latimarginatus*, *Cyrtoceras eugenium*, *Zaphrentis giganteum*, *Favosites limitaris*, and casts of *Pleurotomaria*.

Geneva limestone.—The Geneva was first described and named by Collett (5: pp. 63, 81–82) from exposures at Geneva, Shelby County, Indiana. Kindle (19: p. 537) suggested that this limestone replaced the Sellersburg and Jeffersonville to the north, but later he (20: p. 313) decided that the fauna indicated its age as either Schoharie or Onondaga, probably Schoharie. Cumings (8: p. 466) stated that the actual relationships of the Geneva and Jeffersonville-Sellersburg formations have not been satisfactorily determined, and that the Geneva might be a lithologic facies of one or both of these formations, or more likely a distinct formation older than the Jeffersonville.

In a recent paper D. G. Sutton and A. H. Sutton conclude that

The Geneva is a northward lithologic facies of the Jeffersonville formation of Onondaga age as shown by the Onondaga faunules of the Jeffersonville, which continue into the Geneva at the same horizons and by the lateral transition from the dolomitic Geneva limestone to the purer Jeffersonville limestone. This gradation begins farthest south in the lowest beds and reaches the progressively higher beds toward the north, which makes it appear upon casual investigation that the Jeffersonville thins toward the north, the thinning being accompanied by a corresponding thickening of the Geneva (34: p. 331).

They also suggest that by priority the term "Geneva" should be applied to all Indiana rocks of Onondaga age.

The Geneva first appears in the section 10 or 15 miles north of the Falls-of-the-Ohio, where sections which include both the Jeffersonville and the Niagaran begin to show between them thin beds of rather soft, dark buff to brownish, fine-grained, saccharoidal magnesian limestone, locally cherty. This Geneva type limestone thickens northward as the Jeffersonville limestone thins, and reaches the maximum known thickness of 62 feet on Bear Creek in the NW. $\frac{1}{4}$, SW. $\frac{1}{4}$ of Sec. 30, T. 8 N., R. 8 E.

The presence at the top of the section here of thin beds with *Spirifer acuminatus* and *Stropheodonta hemispherica* indicates that not much if any of the formation is missing. These brachiopods and their associated forms are found wherever the upper part of the Geneva or Jeffersonville is exposed (34: p. 327).

SOUTHERN INDIANA AND KENTUCKY

Inasmuch as the Devonian outcrop in southern Indiana and north-central Kentucky is more or less continuous, and is characterized by the typical expression of the Jeffersonville and Sellersburg formations, this district is treated as a single area in the following descriptions.

The Devonian rocks exposed in Kentucky consist only of the Onondaga and Hamilton limestones. The principal outcrop of these limestones is in a very narrow strip between the Silurian and Ordovician limestones and shales which underlie the Bluegrass region on the crest of the Jessamine dome of the Cincinnati arch, and the encircling outcrop of the Chattanooga black shale. Small patches of Devonian strata are exposed on the Cincinnati anticline south of the main area, along Green and Cumberland rivers and some of their tributaries (Fig. 1). The most complete section of the limestones is to be seen at Louisville, Jefferson County, from which they thin southward by the omission of the lower beds. The pattern of the outcrop curves eastward to Lebanon, Marion County. The eastern and western areas of Devonian rocks are separated for a short distance, at least in the outcrop, across the crest of the Cincinnati anticline between Lebanon and Crab Orchard, eastern Lincoln County.

ONONDAGAN

Jeffersonville limestone.—Kindle (18: pp. 8, 23, 110) described this formation and named it from the city of Jeffersonville, Clark County, Indiana, near the famous coral beds at the Falls-of-the-Ohio where it is so well represented. He defined it as the "lowest formation of the Devonian as developed at the Falls-of-the-Ohio lying between the Sellersburg beds and the *Catenipora* (*Halysites*) beds of the Niagara." These ancient coral reefs attracted attention in the early part of the nineteenth century, and were mentioned by many of the early workers. The name "Corniferous" limestone was applied to all of the Devonian limestones of this area by Eaton (12: pp. 61-71, 198) and the term is still used by oil drillers for undifferentiated limestone strata below the Chattanooga black shale.

The surface distribution of the Jeffersonville limestone is confined to the north-central part of Jefferson County, Kentucky, in the bed and on the banks of the Ohio River, and in Indiana just northwest of Jeffersonville to within $\frac{1}{2}$ mile of the mouth of Silver Creek where it dips below water level. There is no complete section known exposing both top and bottom of the Jeffersonville limestone so the entire thickness is not definitely known. Butts (2: p. 104) gives the following section compiled from exposures near the Whirlpool, one mile west of Jeffersonville.

	Feet
5. Limestone, massive, rather coarse-grained, light-gray, a little black chert locally. Whitish and shelly on weathering. Exfoliates diagonally to the bedding. <i>Spirifer acuminatus</i> about in top. <i>Stropheodonta hemispherica</i> abundant and conspicuous, Bryozoa abundant, includes bryozoan and <i>Nucleocrinus</i> subzones of authors. <i>Spirifer acuminatus</i> zone.	9
4. Limestone, siliceous, cherty, bluish-gray, fine-grained, very hard. <i>Spirifer gregarius</i> , very abundant. <i>Favosites hemisphericus</i> , <i>Turbo shumardi</i> , etc. <i>Spirifer gregarius</i> zone.	2
3. Limestone, 6 inches to 1 foot layers, medium, coarse-grained, light pinkish, bluish, or brownish gray. In places largely made up of <i>Stomatopora</i>	7
2. Limestone, medium thick-bedded, very coarse crystalline, brownish in part. Crowded with corals. Coral layer.	7
Certainly Jeffersonville.	25
1. Limestone, covered with water, not identified.	3

The sequence of lithologic and faunal characters described above is the same wherever the Jeffersonville approaches its normal thickness. The basal coral zone is persistent and wherever the contact with the Silurian is exposed the strata immediately above the *Halysites catenularia* zone are crowded with corals. Likewise the *Spirifer gregarius* zone and the *Spirifer acuminatus* or *Stropheodonta hemispherica* zones persist wherever the Jeffersonville has been observed. The abundance of the fossils of this limestone, especially of the fossil corals, has contributed largely to the fame of the Falls-of-the-Ohio among paleontologists the world over.

HAMILTON

Sellersburg formation.—Kindle (18: pp. 8, 20, 110) named this formation from exposures near Sellersburg, Indiana, and described it as a "fine-grained calcareous sandstone, with a thin bed of limestone at the top, overlain by the New Albany shale and underlain by the Jeffersonville limestone." It is composed of the Beechwood member above and the Silver Creek below. Sutton (34: p. 326) proposes the name "Speeds member" to designate 18 inches of shaly limestone exposed below the Silver Creek at Speeds quarry, near Sellersburg. This thin bed is included in the Sellersburg because of the occurrence in it of *Spirifer audaculus*.

Siebenthal (33: p. 345) named the Silver Creek Hydraulic limestone from exposures on Silver Creek, Clark County, Indiana. He described it as a homogeneous fine-grained, bluish to drab, argillaceous, magnesian limestone, up to 16 feet thick, overlain by the Sellersburg. Butts (2: pp. 118-20) divided the Sellersburg as described by Kindle into the Silver Creek limestone member below and the Beechwood limestone member above. This division is generally accepted. The Silver Creek is most typically exposed along the stream from which it was named. So far as it is known to crop out in Ken-

tucky, the Silver Creek is limited to a relatively small area along the river bank north of Louisville and extending eastward as a thin layer to the lower part of Beargrass Creek in Jefferson County.

According to Butts (2: p. 119) the composition of the Silver Creek ranges approximately 50-60 per cent calcium carbonate, 16-35 per cent magnesian carbonate, 10-25 per cent silica, and 2-5 per cent alumina. Much of the silica is in the form of chert. The Silver Creek is moderately fossiliferous, the most characteristic and abundant forms being brachiopods and pelecypods.

The Beechwood limestone member was named by Butts (2: pp. 118-20) from exposures in a stream "at a point a few rods north of the Shelbyville turnpike one-half mile south of Beechwood, and one and one-half miles east of St. Mathews." He described it as a coarse, crinoidal limestone, 2-8 feet thick, the "Encrinal" limestone of early workers, the Sellersburg of Siebenthal, and the top member of the Sellersburg of Kindle and Butts. It is rather heavily stratified, the lower part being light gray in tone and fairly coarsely crystalline in texture, whereas the upper part is finer-grained and darker in color. The abundance of crinoid stem plates gives it a coarsely crystalline appearance. The Beechwood is separated from the Silver Creek below by irregular bedding planes above which are numerous black phosphate nodules containing small linguloid shells, fragments of bryozoans, crinoid joints and some ostracodes. The contact with the overlying New Albany is sharply demarcated, and commonly the upper few inches of limestone are altered to pyrite. The Beechwood limestone member can be readily recognized in its typical lithologic and faunal characters at only a few localities south of northern Bullitt County. For example, the Beechwood facies can be recognized below the Casey limestone at the type locality in Casey County. Butts (3) described a section which includes the Beechwood on Barren River in Barren County as follows.

	Feet
Chattanooga shale	
1. Shale, black, thin calcareous sandstone layers in the lower 10 feet, the associated shale carrying the characteristic Genesee shale fossils <i>Schizobolus truncatus</i> and <i>Lingula spatulata</i>	43
Devonian limestone	
2. Sandy limestone or calcareous sandstone, chocolate brown, medium textured. Cemented to the underlying limestone. Hamilton age?.....	1*
3. Limestone, gray, coarsely crystalline, highly fossiliferous, crinoid stem plates abundant, also corals, bryozoans, and brachiopods. Layers about 1 foot thick. Some of the crinoid columns like those of the Beechwood ("Encrinal") limestone of the Louisville region, of Hamilton age. "Cap rock" of oil operators.....	5
4. Limestone, bluish-gray, fine-grained, compact, rather distinct in the sec-	

* Probably the Duffin layer which Savage refers to the base of the black shale.

- tion at the mouth of Little Glover Creek 2
5. Limestone, massive, weathers pitted and cavernous, variable in color and texture, sparingly fossiliferous at mouth of Little Glover Creek, coarsely crystalline, very light gray, and full of small sandy lenticles weathering to sandstone. At mouth of Dry Creek, bluish gray, fine grained. Oil bearing stratum of the Devonian; probably Onondaga (Corniferous) age 79

Miller (22: pp. 220-42) correlates the thin Devonian limestone of Allen County with the Beechwood by means of a species of *Dolatocrinus*. Shaw and Mather (32: p. 47) collected fossils from exposures in Allen County and sent them to Ulrich for identification. His discussion is as follows.

The collection comprises four small pieces of nearly pure bluish gray, mainly fine-grained limestone. Two of the pieces contain only columnals of a thick-stemmed crinoid, possibly *Dolatocrinus* or *Megistocrinus*; the third has a weathered coral suggesting a young *Heliophyllum halli*, a very common Middle Devonian fossil; the fourth retains an exfoliated pedicle valve of some terebratuloid brachiopod, possibly *Fanella lincklaeni*. Of these only the coral is at all diagnostic (32: p. 47).

The most characteristic fossils of the Sellersburg are *Spirifer hobbsi*, *Athyris fulltonensis*, *Stropheodonta demissa*, *Clinopitha antiqua*, *Chonetes acutiradiatus*, *Gomphoceras turbiniforme*, *Productella subaculeata cataracta*, *Heliophyllum juvane*, *Rhipidomella vanuxemi*, *Paracyclas lirata*, *Tropidoleptus carinatus*, *Modiomorpha concentrica*, *Pentagonia unisulcata*, *Spirifer fornacula*, *Ambocoelia umbonata*, *Chonetes yandellianus*, and *Spirifer oweni*.

Casey limestone.—The name Casey limestone was proposed by Savage (31: pp. 12, 143-44) for a cherty limestone containing Hamilton fossils which overlies the Beechwood member of the Sellersburg, and is below the Duffin layer in the base of the black shale. It is typically exposed near Kidd's Store, Casey County, Kentucky. The upper part of the Casey is thick-bedded, gray, and rather fine-grained, containing numerous irregular masses of chert. This cherty limestone is widespread south of Bullitt County where its thickness ranges from 3 to 8 feet. In many places it is underlain by thinner-bedded, gray, somewhat sandy limestone, 2 feet or more thick, in the lower few inches of which are crowded shells of *Ambocoelia umbonata*. The fauna of this cherty limestone includes such Hamilton species as *Favosites goodwini*, *Ambocoelia umbonata*, *Pentamerella cf. pavilionensis*, *Productella spinulicosta*, *Reticularia fimbriata*, *Rhipidomella vanuxemi*, *Spirifer varicosus*, *Stropheodonta concava*, and *Platystrophia lineatum*.

The Casey limestone lies between the black shale and the Louisville limestone (Silurian) in southern Bullitt, Nelson, and Laclede counties. Closer to the crest of the Cincinnati arch in Marion, Taylor,

Adair, and Russell counties it rests on progressively older Ordovician formations, with the Silurian strata entirely missing from the outcrop. In Cumberland County, and in the area across the south end of the Jessamine dome, the New Albany shale rests on Ordovician with both the Silurian and the Devonian missing.

Boyle limestone.—Foerste (16: pp. 10, 92) applied this name to the Devonian limestones south of Bullitt County where these strata differ in their typical lithologic and faunal characteristics from both the Jeffersonville and the Sellersburg of the Louisville area. As originally defined, the Boyle included the Duffin (15: p. 145) layer at the top and the Kiddville layer at the base, separated by a thick series of limestones which is in places richly fossiliferous and cherty. Savage (31: pp. 1-21) redefined the name by excluding the Duffin layer which he placed at the base of the black shale.

The most characteristic fossils of the Boyle limestone are thought to indicate its equivalency with some part of the Hamilton, but they are not typically those of either the Silver Creek or the Beechwood limestone members. The upper part, which is a cherty limestone, is the equivalent of Savage's Casey limestone. There is at the base of the Boyle in many places a thin layer of sandstone or sandy limestone that contains numerous fragments of teeth and plates of fishes, which Foerste (16: pp. 92-93) has called the Kiddville layer from a hamlet in Clark County. The lower part of the Boyle is more fossiliferous than the upper, the most common species being *Cystiphyllum americanum*, *Heliophyllum halli*, *Ambocoelia umbonata*, *Athyris spiriferoides*, *Cammarotoechia sappho*, *Pentamerella pavilionensis*, *Spirifer granulosus*, and *Tropidoleptus carinatus*. These are diagnostic Hamilton species, but there are in some places a few associated species which also occur in rocks of Onondaga age.

General summary.—The Casey limestone is the most consistently represented member of the Devonian limestone, and is Hamilton younger than the Beechwood. The Jeffersonville and the Silver Creek (lower member of the Sellersburg) thin to disappearance in southern Jefferson County. The Beechwood has been recognized in a few places south of Bullitt County, as described for Casey, Barren, and Allen counties.

The Boyle limestone represents the entire Devonian limestone sequence south of Bullitt County where the typical subdivisions of the Louisville section can not be differentiated. Its upper limit is the Duffin layer, basal New Albany, and the lower limit is the Silurian. Such units as the Casey, the Beechwood, and the Kiddville can not everywhere be recognized.

CORRELATION

The Camden chert of Tennessee is the equivalent of the Clear Creek chert of Illinois, both lithologically and faunally. Dunbar (11: p. 87) demonstrated that both are Onondagan through faunal evidence and by the fact that the formations are separated by an erosional interval from the typical upper Oriskany strata which they overlie—the Little Saline in the case of the Clear Creek, and Harriman in the case of the Camden. The Little Saline limestone disappears toward the south and east in Illinois, probably due to erosion, and the Clear Creek chert rests directly on the Grassy Knob chert, from which it can be distinguished only by faunal studies.

The Clear Creek grades without a break in deposition into the overlying Dutch Creek sandstone, and the Dutch Creek in turn grades into the Grand Tower. Correlations of the Illinois and Missouri sections were made on paleontologic evidence, but the great physical differences suggest an alternative correlation as shown in Figure 4. J. M. Weller lists the following reasons for favoring this alternative correlation.

(1) In Missouri there is no apparent break between the Little Saline limestone and the overlying beds that have been referred to the Grand Tower, and it does not seem likely that the thick Clear Creek chert could separate them nearby in Illinois

(2) It seems unlikely that two formations as similar as the Beauvais and Dutch Creek sandstones should be persistently present at different horizons in neighboring areas, or if they were, that neither should be even suggested in the area of the other

(3) With this interpretation the Devonian sections of southwestern Illinois and southeastern Missouri become essentially similar except for a general thickening in a southward direction (37: p. 130).

Careful study of the faunas of the two areas must be made before this problem can be solved, not only species studies but the association of the faunules with their environments as reflected in the lithologic variations within the formations.

Savage (27) on the basis of coral reef structures correlated the Jeffersonville in Indiana principally with the upper part of the Grand Tower in Illinois. Workman (40) agreed with this correlation and suggested the equivalency of the Pendleton sandstone and the Dutch Creek. He also suggested that the Lingle and Alto formations might be limestone phases of the Chattanooga black shale.

UPPER DEVONIAN

The only upper Devonian limestone exposed in the area involved in this study is the Alto, reported to overlie the Lingle limestone dis-

conformably in Union County, Illinois, where it varies 40-70 feet in thickness. The Alto was described by Savage (28: pp. 169-78) and named from an exposure along a creek in Alto Township, Union County. It consists of a dark, siliceous shale and somewhat shaly limestone. In places it is almost lithographic and includes small chert nodules. The fauna is not particularly diagnostic of any one division of the Devonian, the more common fossils being *Chonetes scitulus*, *Cryptonella eudora*, and *Leiorhynchus mesocastalis*.

SUBSURFACE STRATIGRAPHY

The study of cuttings from approximately forty wells drilled into or through the Devonian strata of western Kentucky has served to

		TENNESSEE	ILLINOIS	MISSOURI	INDIANA	KENTUCKY	ALTERNATIVE CORRELATION	
							ILLINOIS	MISSOURI
UPPER DEVONIAN	GENESSEE	BREAK	ALTO	BREAK	BREAK	BREAK	ALTO	BREAK
	HAMILTON	SELLERSBURG	LINGLE	ST LAURENT	BEECHWOOD SILVER CREEK SPEEDS	SELLERSBURG CASEY BEECHWOOD SILVER CREEK	LINGLE MISENHEIMER GRAND TOWER	ST LAURENT
	PEGRAM	BREAK	MISENHEIMER	BEAUVAIS	BREAK	BREAK	DUTCH CREEK	BEAUVAIS
	MARCELLUS	JEFFERSONVILLE	GRAND TOWER	GRAND TOWER	JEFFERSONVILLE	JEFFERSONVILLE	CLEAR CREEK	GRAND TOWER
	ONONDAGA	CAMDEN	DUTCH CREEK CLEAR CREEK		PENDELTON			
		HARRIMAN	LITTLE SALINE	LITTLE SALINE	BREAK	BREAK	LITTLE SALINE	LITTLE SALINE

FIG. 4.—Generalized sections of Middle Devonian. Alternative correlation as suggested by Weller (37: p. 130).

confirm the zoning system suggested in an earlier preliminary report,⁶ and has indicated probable correlations with the Devonian strata cropping out in neighboring areas.

The zoning of the formations below the Chattanooga shale was based on certain distinct microlithologic differences and the characteristics of the insoluble residues. For utilitarian reasons the numbering system adopted is the reverse of the usual geological procedure of starting with the oldest formation. Geologists engaged in subsurface oil-field work commonly zone from the top downward as this method permits new zones to be added if the field is later explored for deeper producing beds. If the correlations suggested in this paper are confirmed when additional data become available, the formation names should then be substituted for the zone numbers.

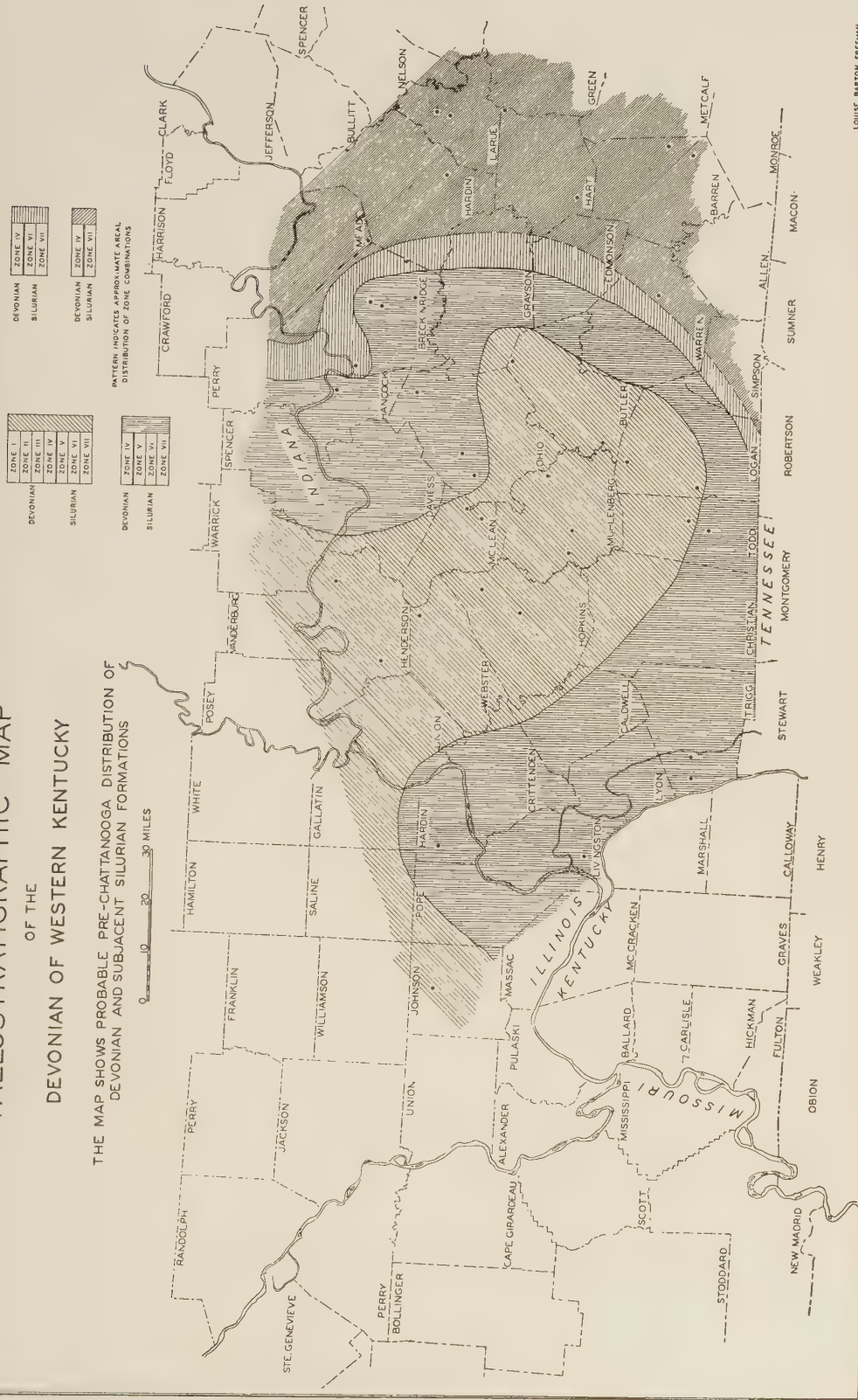
⁶ Louise Barton Freeman, "A Sample Study of the Devonian in Western Kentucky," *Kentucky State Dept. Mines and Minerals*, Ser. 8, Bull. 4 (1939).

LEGEND

OF THE

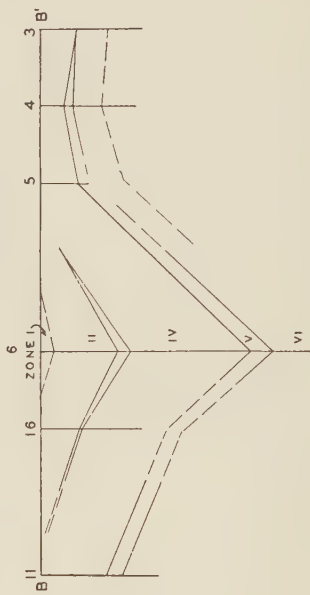
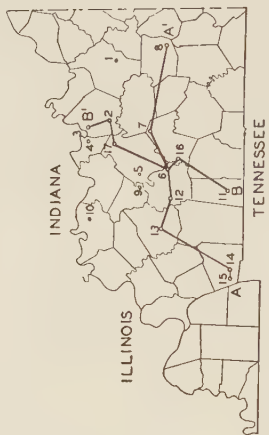
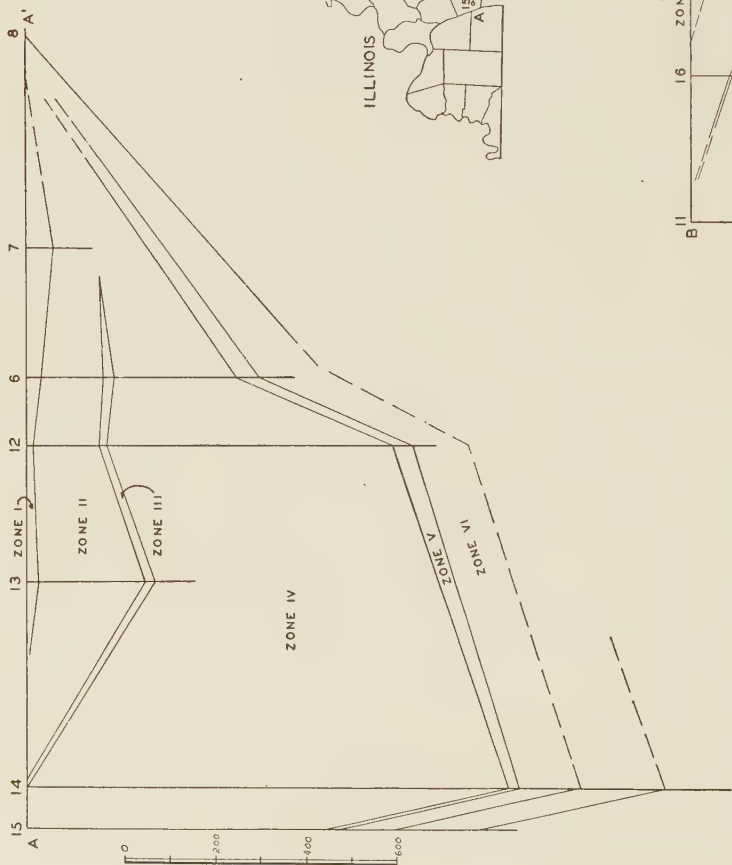
DEVONIAN OF WESTERN KENTUCKY

THE MAP SHOWS PROBABLE PRE-CHATTANOOGA DISTRIBUTION OF DEVONIAN AND SUBJACENT SILURIAN FORMATIONS



LOUISE BARTON FREEMAN

FIG. 5



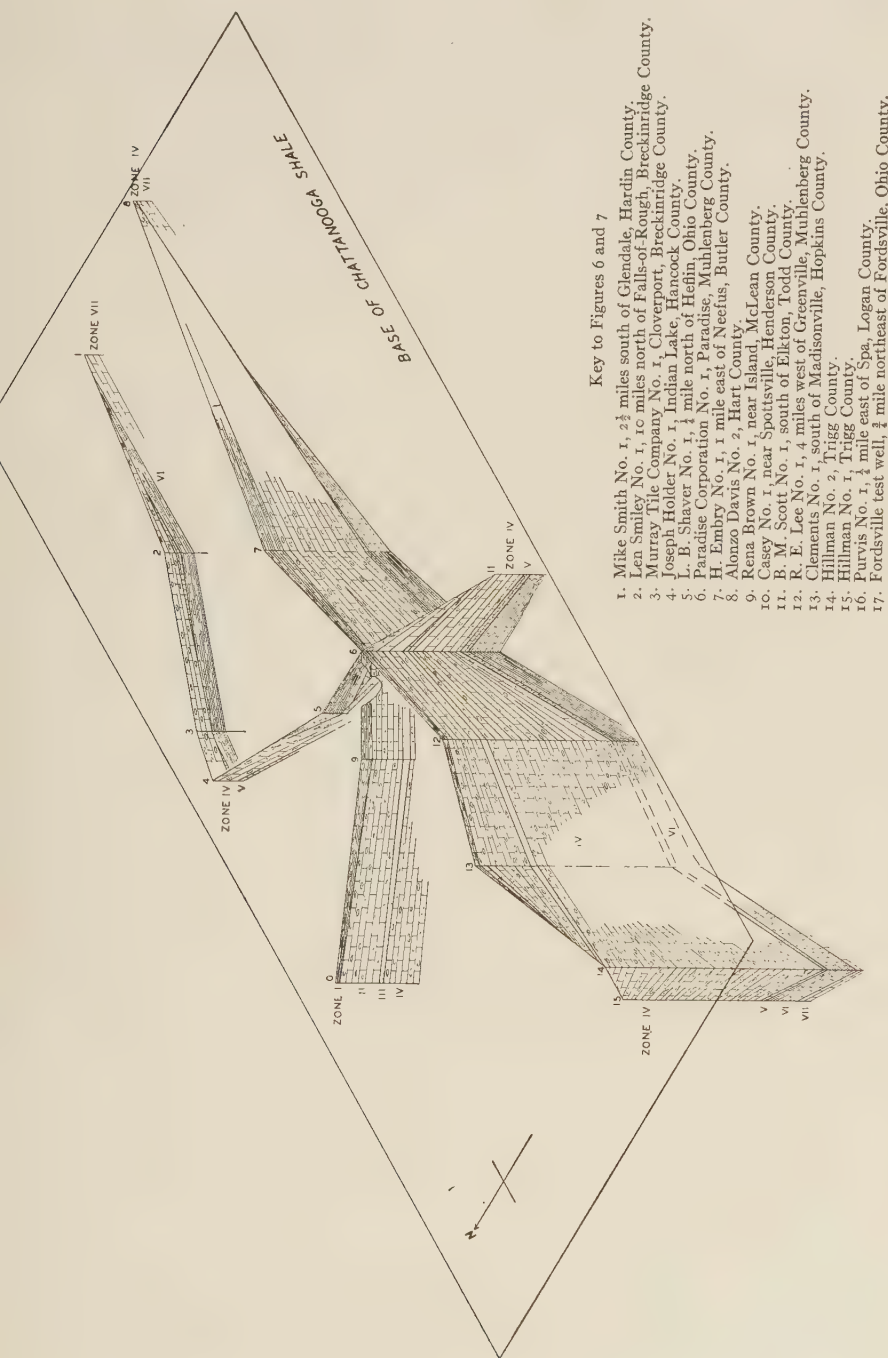


FIG. 7.—Composite correlation diagram showing relation of Devonian and subjacent Silurian formations in western Kentucky.

A well drilled at Paradise⁷ in Muhlenberg County penetrated stratigraphically deeper below the shale than any of the others having a complete section. For that reason the section encountered in it was used as a guide to which all other samples were compared.

Because the upper part of the Silurian also lends itself readily to zoning, and since the Lower Devonian sequences do not rest on the same Silurian formations in all areas, three zones are herein suggested for the Silurian strata most commonly encountered.

Figure 5 is a paleostratigraphic map indicating approximate areas where partial or complete zonal sections are represented beneath the Chattanooga. In the deepest portion of the basin all zones of the Devonian and subjacent Silurian are present. In a semicircular area around the center, opening to the north, the three upper zones of the Devonian rest on a complete Silurian zonal section. To the east there is a narrow strip where the lowest zone of the Devonian rests on the second Silurian zone, the upper zone, the Decatur limestone, having been removed. The available information indicates that the complete Silurian section continues westward. Still farther east, and higher on the flank of the Cincinnati arch, another Silurian zone, the upper Brownsport or Louisville, disappears. In this area if there are any Devonian rocks present, they are only a few feet in thickness and rest on the lowest zoned part of the Silurian.

Hence the map shows not only pre-Chattanooga areal geology but also the approximate stratigraphic section for the Devonian and upper part of the Silurian limestones. The fact that the Decatur and upper Brownsport limestones (Zones V and VI) are present south and west but disappear towards the Cincinnati arch suggests post-Silurian uplift of the arch—a reflection of the Caledonian movement elsewhere. The evidence from these subsurface studies affords the first indication that Silurian strata younger than Louisville were ever deposited in western Kentucky. The arch probably remained a positive structure during most of Devonian time, thus accounting for the non-deposition of some of the Lower Devonian strata. Pre-Chattanooga uplift with emphasis on the Nashville dome cut off the south end of the basin and permitted erosion of the upper Middle Devonian formations from the east, south, and west sides. Figures 6 and 7 show the wedging of some formations and the complete removal of others by pre-Chattanooga or pre-Helderberg erosion.

SILURIAN

ZONE VII

Underlying the upper Brownsport type Zone VI on the west side

⁷ A list of the wells used in this study and their locations is given on page 700.

and extending well toward the center of the basin is red and gray mottled, fine-grained limestone of Bainbridge or Wayne characteristics. The red color is lost higher on the flank of the Cincinnati arch, but the texture of the limestone remains relatively constant. This results in a gray, fine-grained, magnesian limestone lithologically similar to the Louisville "high" on the side of the structure.

Additional zones may be added below Zone VII if deeper drilling makes available information regarding the characteristics of the lower formations of the Silurian and the Ordovician.

ZONE VI

This zone was reached in the deeper part of the basin only in the Paradise well, but most of the wells from Trigg County on the southwest to Breckinridge on the northeast encountered it. It is dark gray, dull, shaly, fossiliferous limestone, 50-60 feet in thickness. The residue is leached gray shale, rather coarsely porous, and shows fragmentary impressions of such fossils as bryozoans, brachiopods, and crinoid stem plates. In northern Ohio County and Hancock County there is near the top considerable limonite, showing a peculiar regular pore arrangement suggestive of fossil replacement. This material occurs as irregular fragments with no indication of what fossils are represented. The pores, which are 0.01 to 0.02 millimeter in diameter, are the openings to tubes which are arranged in parallel rows through the mass of the fragments.

A near-by well at Cloverport, Breckinridge County, at this horizon has considerable siliceous limonite in the sample. There is a small amount of blue-white chert in this zone, showing banding and in many places occurring as partial replacements of fossils. On the west side of the basin this horizon includes some glauconite. It is suggested that this argillaceous limestone, overlying typical Bainbridge and Louisville types of limestone and underlying the lithologic facies suggestive of Decatur, is equivalent to the upper Brownsport of the Tennessee section.

ZONE V

This zone is represented in all wells that penetrated the Silurian west of the Murray and the Howard wells in Breckinridge County. It varies from a few feet to as much as 30 feet in thickness, and disappears in the short distance between Indian Lake, Hancock County, and Cloverport, Breckinridge County, and between the Smiley and the Howard wells in central Breckinridge County, east of which it has not been encountered.

The cuttings are of white, coarsely crystalline limestone in the

top few feet, below which are introduced delicately tinted pink and pale green fragments. The limestone of the lower part of this zone is a mixture of buff and white. Acid treatment leaves a very small residue made up almost entirely of chalcedonic quartz or partial fossil replacements, which, in the lower part, reflect the yellow color of the original sample. Some of the lowermost samples show a little light green shale, and, particularly in the wells of Ohio, Breckinridge, and Hancock counties, an exceptionally high per cent of pyrite. Limestone of this type contrasts sharply with the Devonian cherty dolomites above, and with the argillaceous limestones of Zone VI below. On the basis of its lithology and position it is correlated with the Decatur (Middle Silurian) limestone of the Tennessee section.

DEVONIAN

ZONE IV

This zone is represented in its full extent in the Paradise well, where it is 300 feet thick. Most of the wells are drilled only about 100 feet into this zone. In a semicircular strip around the basin proper, open toward the north, the Chattanooga rests directly on some part of Zone IV (see Fig. 5). This zone thickens within a short distance west, partly due to stripping on the east as the flank of the Cincinnati arch is approached, and partly by deposition, as demonstrated by the difference in its thickness in the Paradise and Hillman wells in each of which the full section is present (Fig. 6).

Lithologically the strata of Zone IV resemble somewhat those of Zone II. Zone IV, however, is considerably more dolomitic and ordinarily contains two or more strata rich in glauconite. The chert in the upper part, which is mottled grayish tan and in some places doloclastic, may make up 40 per cent of the sample. There is a limestone interval about in the middle of Zone IV, which is less dolomitic and less cherty than the strata above and below, and which can be recognized in nearly every well which has been drilled deeply enough to encounter it. This limestone is white and coarsely crystalline, and the chert is white, chalky, and doloclastic. The per cent of chert and dolomite again increase in the lower part of the zone. The lower chert is mainly brown with white inclusions, some of which are undoubtedly sponge spicules, and others suggest radiolarian remains. In some cases the chert is translucent white with dull white markings. Cherts of this description have been recognized in the deeper wells in the main part of the basin and in the strip surrounding this area where the Chattanooga rests on some part of Zone IV.

The contact with the arenaceous Zone III above is sharply delineated, and the change from cherty, dolomitic limestone of the Devonian to the unmistakable Silurian limestone below is easily recognized.

Zone IV is tentatively correlated with the Clear Creek chert, the Grassy Knob (Oriskany) chert, and the underlying Helderberg cherts. Workman (40), in his studies of the subsurface Devonian of Illinois, has been unable to differentiate between these formations and in his paper refers them all to the Grassy Knob-Bailey.

ZONE III

This zone is present in all the wells studied in the basin proper and a suggestion of it appears directly under the shale as far west as the Hillman No. 2 well in Trigg County. The zone is in general thin, reaching its maximum known thickness of about 50 feet in wells in McLean and Hopkins counties. It is marked at the top by a sharp change from the cherty limestones of Zone II to white, pure, coarsely crystalline limestone which grades downward into a sandstone. In the southernmost wells the proportion of sand to calcareous material does not exceed 25 per cent. The sand grains are poorly sorted as to grade size, but they are all well rounded and frosted. The per cent silica and the grade size decrease near the base and near the top. In other words, the most uniformly coarse sand is found near the middle of the deposit. Wells in Henderson County have thinner sections of sandstone, but the grains are coarser and show some polishing in addition to the rounding and frosting. The western trend of this sandy horizon can not be outlined accurately at this time as there is no information available concerning the strata in the area between the wells in Hopkins and Muhlenberg counties, and the wells of Trigg and Livingston counties some distance west. It is probable that the sandstone strata are the equivalent of the Dutch Creek sandstone of Illinois, and possibly of the Pendleton sandstone of Indiana. Workman (40), of the Illinois Geological Survey, has suggested that the Pendleton and Dutch Creek are correlatives.

ZONE II

Zone II varies in thickness from 25 feet in the Darden well, Logan County, to 220 feet in the Clements well, Hopkins County. The Ramsey well in Hopkins County, and the Embry in Butler County, did not reach the base of Zone II. The rocks of Zone II are composed of white to light tan, coarsely crystalline, cherty limestone, slightly dolomitic. The residue makes up 5-50 per cent of the original and is mainly

dull, mottled, light tan and gray or white chert with a few black inclusions. The chert at the top is white or very light tan, but that near the base is darker brown with dolocasts rare. This basal chert breaks into thin flakes which are translucent with a dark oily luster, and they contain dark inclusions.

As in the case of Zone I, this cherty limestone is restricted to the deepest part of the basin with a connection into Illinois and Indiana toward the north. Contacts with the dark argillaceous limestone above and with the arenaceous limestone below are sharp and readily discerned even in a cursory examination of the samples. The zone is tentatively correlated with the Grand Tower limestone of southwestern Illinois and southeastern Missouri.

ZONE I

Zone I varies in thickness from 31 feet in the Paradise well to 76 feet in the Morris well in McLean County. The original samples show a dense, fine-grained, dark brownish gray, argillaceous limestone, in some places fossiliferous. These samples leave a large residue of very finely porous shale which is dark brownish gray near the top with light tan, more coarsely porous shale near the base. A little blue chert and pyrite may be present. The diminishing amount of shale residue downward and the increase of the chert content are easily recognizable markers for the base of Zone I.

As indicated on the accompanying map and diagram (Fig. 5 and Fig. 7) this zone is represented only in the wells in the deeper part of the basin from which its strata thin toward the south and east. The zone persists northward into Illinois where, judged by its lithologic character and position in the section, it is probably the equivalent of the Lingle, Misenheimer, and Alto formations.

LIST OF WELLS USED IN THIS STUDY⁸

- Barron County, J. E. Eaton, drilled by Louisville Gas and Electric Company, 1 mile southwest of Temple Hill
- Barren County, C. E. Glass, drilled by Louisville Gas and Electric Company, near Keno
- Butler County, E. E. Brown, near Penrod
- Butler County, (7) Minnie Embry, drilled by W. H. Ford, 1 mile southeast of Neefus
- Breckinridge County, Davis No. 1, drilled by Allison *et al.*, 3 miles east of Harned
- Breckinridge County, Fannie McCoy No. 1, drilled by Lion Oil Company, 3 miles east of Garfield
- Breckinridge County, Ben Howard No. 1, drilled by Louisville Gas and Electric Company, 2 miles north of Constantine, near the Hardin-Breckinridge counties line
- Breckinridge County, (3) Murray Tile Company No. 1, drilled by Galey and Flesher, Cloverport

⁸ A number in parentheses before the name of a well indicates that it was used in the cross-sectional diagrams (Figs. 6 and 7).

- Breckinridge County, (2) Len Smiley No. 1, drilled by H. C. Hume and A. J. Early, 10 miles north of Falls-of-Rough
- Hancock County, (4) Joseph Holder No. 1, drilled by Galey and Flesher, 1 mile east of Indian Lake
- Hardin County, L. L. Mathier, drilled by Louisville Gas and Electric Company, corner of Hardin, Nelson and Larue counties
- Hardin County, (1) Mike Smith No. 1, drilled by Louisville Gas and Electric Company, 2½ miles south of Glendale
- Hart County, (8) Alonzo Davis No. 2, drilled by Cumberland Petroleum Company
- Hart County, Ransom Lewis No. 1
- Henderson County, (10) J. E. Casey No. 1, drilled by Magnolia Oil Company, near Spottsville
- Henderson County, Sheffer Heirs No. 1, drilled by Phillips Petroleum Company, near Corydon
- Hopkins County, (13) Clements No. 1, drilled by Gulf Oil and Refining Company, south of Madisonville
- Hopkins County, Parker No. 1, drilled by Phillips Petroleum Company, near Vendetta
- Larue County, G. W. Beard No. 1, drilled by Louisville Gas and Electric Company
- Larue County, Nannie Larue No. 1, drilled by Louisville Gas and Electric Company
- Livingston County, H. L. Dunn, drilled by J. Harvey Dunn, south of Smithland
- Logan County, Darden No. 1, near Russellville
- Logan County, (16) R. V. Purvis, drilled by R. W. Gray and Wicklund Development Company, ¼ mile east of Spa
- McLean County, (9) Rena Brown No. 1, drilled by South Penn Oil Company, south of Island
- McLean County, L. E. Morris No. 3, drilled by Miller, Damron and Callas, Barrett Hill
- Meade County, A. E. Hardaway No. 1, drilled by Louisville Gas and Electric Company, ¾ mile northeast of Big Spring
- Muhlenberg County, (12) R. E. Lee, drilled by Ohio Oil Company, 4 miles west of Greenville
- Muhlenberg County, (6) Paradise Corporation Well No. 1, drilled by South Penn Oil Company, at Paradise
- Muhlenberg County, Rice Brothers No. 3, drilled by J. C. Ellis, near Friendship Church
- Ohio County, (17) Corniferous test well at Fordsville, junction of three farms, the G. H. Roberts, G. E. Fuqua and S. Lancaster Estate, drilled by Galey and Stewart, Cumberland Petroleum Company, and Snowden and McSweeney
- Ohio County, (5) L. B. Shaver No. 1, drilled by Callas, Stephenson and Galey, ¼ mile north of Heflin
- Ohio County, Vance No. 1, near Beda
- Todd County, J. N. Haddon No. 1, drilled by A. A. Peard, north of Elkton
- Todd County, (11) B. M. Scott No. 1, drilled by J. A. Eubank, 1 mile east of Elkton
- Trigg County, (15) Hillman No. 1 and (14) Hillman No. 2, drilled by Ada Belle Oil Company
- Warren County, Lena Doyle No. 1
- Webster County, J. R. Ramsey No. 5, drilled by Iley Browning, near Sebree

SAMPLE DESCRIPTIONS

Detailed sample descriptions are here given for the wells used in Figures 6 and 7, with the exception of those wells drilled with a rotary rig.⁹ Such descriptions have been made for every set of samples studied for this report but it was not considered necessary to include such details for every well as much of the material would have been repetitious. Hence the data for only the most significant wells have been chosen for presentation.

⁹ The number in parentheses before the name of the well indicates that it was used in the cross-sectional diagram (Figs. 5 and 6).

(1) MIKE SMITH NO. 1, HARDIN COUNTY

Depth in Feet

ZONE IV

- 845- 840 Limestone, some of which is dense brown, some light-colored; much black shale from above

ZONE VII

- 846- 851 Limestone, white and in places pale green, fine-grained with finely disseminated pyrite and a few fragments of green shale
 ~ 861 Dolomite, greenish gray, finely crystalline, calcite only as fragments of crinoid plates
 ~ 875 Dolomite as above with addition of some blue-white, dense, and some translucent and oölitic chert
 ~ 915 Dolomite, brown, crystalline; little blue-white chert, some of which is disseminated in small particles through the dolomite

(2) LEN SMILEY NO. 1, BRECKINRIDGE COUNTY

ZONE IV

- 1,308-1,318 Limestone, slightly dolomitic, white, crystalline, rare fragments blue-white with included pyrite; crinoid plates partly replaced with silica
 1,323 Limestone, white, coarsely crystalline; some dark brown argillaceous limestone, in places with black inclusions, and in places showing irregular clustering of dark crystals
 1,320 Limestone, light tan crystalline, crinoidal, a few plates replaced with silica
 1,342 Limestone, rather fine-grained white to tan, slightly dolomitic; some chert, irregular masses of white enclosed in translucent brown, some dolocasts
 ~1,355 Limestone, white to tan crystalline, occasional fragments showing film of carbonaceous material on polished surfaces; 25-40 per cent chert, finely mottled, dense with brown inclusions
 1,350 Limestone, white to light tan crystalline; much less chert than above

ZONE V

- 1,367 Limestone, white coarsely crystalline
 1,370 Limestone as above with introduction of brown, finely crystalline dolomite; a little pale gray or green dolomite

ZONE VI

- 1,393 Limestone, white to tan crystalline, fossiliferous with partial replacement of crinoid plates with brown quartz; some slightly calcareous dark gray shale
 1,415 Limestone, very dark gray, argillaceous with some very fine sandy material, fossiliferous with fragments of brachiopods prominent
 1,430 Limestone, very argillaceous, leaving greenish, porous shale residue; some more crystalline limestone showing a few fragments of smooth ostracodes

ZONE VII

- 1,430 Limestone, tan, coarsely crystalline, fossiliferous; few fragments argillaceous, and few scattered grains of fine sand
 1,440 Limestone, white crystalline, fossiliferous; some dark gray argillaceous and sandy limestone, the sand grains being very fine, and the shaly material green with some glauconite
 1,480 Limestone and dolomite, greenish gray argillaceous, some fine sand, slightly fossiliferous; about 50 per cent porous shale residue
 1,487 Some dolomite as above; some coarsely crystalline white to light gray limestone, fossiliferous with crinoid stem plates and a few smooth ostracodes
 1,497-1,518 Limestone, white crystalline, slightly dolomitic; little dark gray calcareous shale; glauconite; some fine dolomite with very fine sand

(3) MURRAY TILE COMPANY NO. 1, BRECKINRIDGE COUNTY

ZONE IV

- 1,508-1,576 Limestone, crinoidal and a little gray argillaceous limestone; little blue-white translucent chert

- 1,584 Limestone and dolomite, white crystalline; chert white and tan mottled with a few dolocasts
- 1,606 Limestone, more dolomitic than above; less chert but dolocasts more numerous, some chert showing banding and being coated with drusy tan quartz
- 1,615 Limestone, tan, dense, very little dolomite as rhombs in mottled tan chert; few large fragments of tan calcite from crinoid fragments
- 1,637 Limestone, white coarsely crystalline; very little mottled tan and white chert and some drusy quartz

ZONE VI

- 1,650 Limestone, gray, argillaceous, fossiliferous with rare smooth ostracodes and *Streblotrypa*
- 1,655 Limestone, white coarsely crystalline and dolomitic; very little chert
- 1,660 Dolomite, white to tan, finely crystalline; some tan porous shale in residue and secondary replacement of chalky chert
- 1,681 Limestone, slightly dolomitic; more chert than above, some dense and dull white to light brown, some porous white, here and there blue-white fragments; pyrite; much bright red siliceous limonite in lower part
- 1,700 Limestone and dolomite, finely crystalline, few chert fragments and porous shale in residue; little glauconite
- 1,720 Limestone with some dolomite, coarsely crystalline; some oölitic chert
- 1,737 Limestone, white to tan crystalline, crinoidal; little tan, argillaceous limestone; a few encrustations of crystalline quartz
- 1,760 Limestone, slightly argillaceous, very fossiliferous with crinoid fragments, fenestrated bryozoans, rare ostracodes, a few brachiopod fragments with one complete *Ambocoelia*

ZONE VII

- 1,765 Dolomite, gray, finely crystalline with little argillaceous material; quite fossiliferous with mainly crinoid stem plates
- 1,770 Limestone, white and gray crystalline, some dark inclusions which may be phosphatic
- 1,792 Dolomite, white, finely crystalline; little chert, some of which is porous and rotten; little gray crystalline limestone near base

(4) JOSEPH HOLDER NO. 1, BRECKINRIDGE COUNTY

ZONE IV

- 1,751-1,765 Limestone, gray crystalline, some has dark inclusions, some has glauconite inclusions; crinoidal; few fragments of argillaceous limestone leaving residue of coarsely porous brown clay; few fragments of bluish chert, some as replacements of crinoid plates
- 1,770 Limestone, tan crystalline with a little argillaceous material; residue is porous shale from argillaceous limestone and some fragments of chalcudonic replacements
- 1,775 Limestone, dolomitic, white to tan crystalline; chert is mainly dull white and dolocastic; little chalcedony as replacements
- 1,784 Limestone, dolomitic, white coarsely crystalline; chert is either chalky white and dolocastic, brown mottled with white spicular markings, or chalcedony
- 1,810 Limestone, dolomitic, white to tan coarsely crystalline; very little chert, tan dolocastic, in places mottled dull tan to translucent
- 1,815 Limestone, white to tan coarsely crystalline; no chert; little very finely crystalline quartz as coatings
- 1,835 Limestone, white crystalline to dense brown finely crystalline; about 12 per cent chert, brown and tan mottled, and some brown with white markings

ZONE V

- 1,846 Limestone, white and pink, coarsely crystalline; much pyrite
- 1,850 Limestone as above with addition of some pale green limestone and rare grains of fine sand
- 1,873 Limestone, coarsely crystalline with buff staining; much pyrite in residue and some papery greenish gray shale in lower part

ZONE VI

- I,908 Limestone, greenish, argillaceous with many crinoid remains

(5) L. B. SHAVER No. 1, OHIO COUNTY

ZONE IV

- 2,282-2,295 Limestone, slightly dolomitic, very coarsely crystalline; 10 per cent chert white chalky, rare dolocasts
 -2,306 Limestone, light tan crystalline; 30 per cent chert, some white mottled dull and translucent, some very dark brown and dense, and some brown translucent with dark flecks and white spicules
 -2,330 Limestone, very slightly dolomitic, white; little dull white to drusy chert; little fissile green shale near base

(6) PARADISE CORPORATION No. 1, MUHLENBERG COUNTY

ZONE I

- 3,385-3,419 Limestone, white to gray crystalline, some fine-grained rounded sand; little argillaceous limestone leaving spongy shale residue

ZONE II

- 3,427 Limestone, white, crystalline and dolomitic; less than 5 per cent residue of chert, dull to vitreous and some doloclastic
 -3,449 Limestone, white to light tan, crystalline and dolomitic; chert residue, some dull, mostly vitreous bluish white or mottled dull and translucent, a few dolocasts
 -3,494 Limestone, white, crystalline, dolomitic; little chert, some tan and dull, some drusy
 -3,498 Limestone, white to tannish gray, dull as above but more cherty; chert, amber-brown to opalescent, breaking into thin sharp fragments some of which show dark flecks, some showing dolocasts
 -3,518 Limestone, much lighter in color than above, white with rare bluish gray flecks and some tannish dull to crystalline; very little chert
 -3,527 Limestone, finely crystalline, brown; very little dull, mottled brown chert
 -3,536 Limestone, tan, finely crystalline; about 35 per cent chert, some vitreous amber-brown with dark flecks, some very finely porous and mottled tan
 -3,538 Limestone, tan and siliceous as above with about 30 per cent residue of finely porous tan chert

ZONE III

- 3,547 Limestone, white to light tan, finely to coarsely crystalline; no chert
 -3,567 Limestone, coarsely crystalline, white; 5-20 per cent fine to medium size sand, all grains rounded and frosted
 -3,572 Limestone, dolomitic, white, crystalline; some fine rounded and frosted sand as above; some doloclastic white chert

ZONE IV

- 3,585 Limestone, dolomitic, white to light gray, mottled; about 15 per cent chert, light gray with a few dark markings and dolocasts, much mottled with white spicular inclusions, some tan similarly marked with white inclusions
 3,587-3,627 Limestone, dolomitic, white to light gray; chert, white with a few dolocasts and a few fragments showing spicular markings as above
 -3,649 Limestone as above; chert is more doloclastic and has a few fragments of blue-gray chert and tiny doubly terminated quartz crystals; some glauconite
 -3,670 Limestone, dolomitic, fine white to light tan; very little chert as above; some glauconite inclusions and pyrite
 -3,675 Limestone, dolomitic, more gray and crystalline than above; about 5 per cent chert, mottled and slightly doloclastic
 3,680-3,696 Limestone, dolomitic as above, much coarser-grained; about 20 per cent chert, grayish semi-translucent background with fine white markings and few dolocasts
 -3,740 Limestone, white crystalline; some chert, chalky white and doloclastic; little drusy quartz and pyrite
 -3,770 Limestone, dolomitic, white crystalline; about 20 per cent chert, white, spicular, occasional dolocasts and dark inclusions

- 3,775 Limestone, dolomitic, white to cream with about 20 per cent cream chert, dull to translucent
- 3,834 Limestone, dolomitic, light tan crystalline; chert, tan, some spicular, some doloclastic
- 3,863 Limestone, tan, dolomitic and cherty; chert, very doloclastic, some translucent with white spicules, some blue-white; glauconite in upper part
- 3,866 Limestone, dolomitic, tan finely crystalline; chert, very doloclastic, tan mottled with white spicules; glauconite

ZONE V

- 3,868 Limestone, white, coarsely crystalline, dolomitic; some glauconite
- 3,879 Limestone, white, coarsely crystalline, dolomitic, with pale pink and green staining; very small residue of drusy quartz and pyrite
- 3,885 Limestone, white crystalline and buff with pink and green staining; the drusy quartz residue shows yellow stain
- 3,890 Limestone as above but more green and considerable glauconite

ZONE VI

- 3,905 Limestone, gray, finely silty, some greenish; some bluish gray chert
- 3,910 Limestone, gray, crystalline and argillaceous, fossiliferous; many brownish crinoid stem plates in the gray matrix; little blue-gray chert
- 3,918-3,972 Limestone, dense, gray, argillaceous, fossiliferous as above; residue is porous gray silt and clay with a little glauconite

(7) H. EMBRY NO. 1, BUTLER COUNTY

ZONE I

- 1,896-1,915 Shale, black, slightly calcareous; residue is porous brown shale
- 1,924 Shale as above; some limestone, gray, dense, some argillaceous, some crystalline; few fragments of blue chert and some pyrite
- 1,979 Limestone, gray-brown, some argillaceous leaving porous tan shale as residue; some crystalline limestone
- 1,985 Limestone, less argillaceous than above, some crystalline and having spotted appearance due to enclosed pyrite and glauconite; few fragments of smooth ostracodes

ZONE II

- 1,986-1,994 Limestone, white to light gray, coarsely crystalline, crinoidal; a little fine sand
- 2,010 Limestone, dolomitic, white crystalline; chert is white to cream, doloclastic, some banded with fillings of crystalline quartz; little glauconite
- 2,022 Limestone, white, crystalline; chert is chalky, soft and porous with only a little translucent white chert
- 2,065 Limestone, white to tan, coarsely crystalline, crinoidal, fossiliferous; no chert

(8) ALONZO DAVIS NO. 2, HART COUNTY

ZONE VI

- 375-382 Limestone, white crystalline; little very fine sand; a few dolomite rhombs enclosed in black shale
- 389 Limestone, light gray to white with chert, some of which is intergrown with limestone. Residue is chert, blue-white translucent, breaking with conchoidal fracture
- 396 Dolomite, white, evenly crystalline; little chert as above; sand grains

ZONE VII

- 410 Dolomite, white, more coarsely crystalline than above, with thin streak of green, fissile shale; some angular porosity in dolomite
- 438 Dolomite, white, coarsely crystalline with regular pore space; a few grains are bluish in color; flakes of green, fissile shale
- 452 Dolomite, gray, less regularity of crystal size and less porosity; little finely disseminated silica and pyrite
- 459 Dolomite, white, coarsely crystalline with high porosity; a little greenish dolomite, more finely crystalline with a little finely disseminated silica; a few oolites of dolomite, each coated with fine crystals of tan dolomite

(9) RENA BROWN No. 1, McLEAN COUNTY

ZONE I

- 3,474-3,479 Limestone, dark gray; very small residue of dark brown and gray shale; some pyrite and translucent chert
 -3,505 Limestone, dark gray argillaceous, leaving residue of soft brown shale; occasional blue chert fragments and pyrite
 -3,520 Limestone, dark gray argillaceous as above

ZONE II

- 3,529 Limestone, white and brown, coarsely crystalline; some brown chert and fine sugary quartz
 -3,556 Limestone, dolomitic; chert, brown, some doloclastic and some with brown oily lustre
 -3,616 Limestone, white crystalline; little white and brown chert, some of which shows fossil molds; few dolocasts
 -3,677 Limestone, brown, dolomitic; chert is brown and white, much of the brown with oily luster, a little is doloclastic

ZONE III

- 3,714 Sand, some iron-stained, fairly well sorted, well rounded and frosted grains with calcareous cement
 -3,720 Sand, coarse grained, white, mostly angular but many grains show rounding and frosting, then fracture

ZONE IV

- 3,746 Limestone, dolomitic, white; chert is dense, white to mottled grayish tan, doloclastic, some with dark inclusions; a few sand grains; high per cent of pyrite some of which shows dolocasts
 -3,817 Limestone, dolomitic, white; chert is mottled white to gray, some dolocasts; some chert fragments show encrustations of tiny quartz crystals

(10) CASEY No. 1, HENDERSON COUNTY

ZONE I

- 3,999-4,003 Limestone, dense, brown, some crystalline and some argillaceous; residue of finely porous clay material and brown or blue-white chert
 -4,021 Limestone, slightly dolomitic, dense to crystalline, brown; about 25 per cent brown chert
 -4,038 Limestone, dense, brown argillaceous
 -4,057 Limestone, dolomitic, white to light tan, very coarsely crystalline; only a little argillaceous residue

ZONE II

- 4,066 Limestone, dolomitic, white, coarsely crystalline; chert, tan and white mottled with a few dolocasts
 -4,071 Limestone, dolomitic, white to tan crystalline; about 25 per cent chert, most of it brown with some inclusions of white siliceous bryozoan fragments, some doloclastic
 -4,107 Limestone, cream to tan, finely crystalline; less chert than above, some mottled white and some translucent tan
 -4,115 Limestone, slightly dolomitic, cream-colored, crystalline; little cream-colored siliceous material, mainly as partial replacements of bryozoans and crinoids
 -4,127 Limestone, tan, coarsely crystalline; chert, dense and tan
 -4,197 Limestone, dolomitic with the dolomite in small brown rhombs, crinoidal; very little chert as fine, slightly doloclastic, dull material
 -4,211 Limestone, white to brown crystalline; chert, about 10 per cent, dark brown, some with dark flecks, some with white inclusions, some doloclastic

ZONE III

- 4,217-4,225 Limestone, slightly dolomitic, white, coarsely crystalline; little rounded and frosted sand, mostly large grains
 -4,228 Sandstone, dolomitic, very coarse grained, large rounded and frosted grains, many of them showing secondary crystal growth
 -4,239 Limestone, dolomitic; some sand as above, some white chert with gray splotches and dolocasts

ZONE IV

- 4,242 Limestone, dolomitic, white, in places marked with gray; about 10 per cent chert, white to light gray with white markings, doloclastic

- 4,254 Limestone, dolomitic, finely crystalline, tan; about 50 per cent chert, doloclastic, grayish tan, some brown with spicular markings
- 4,315 Limestone, dolomitic, white, coarsely crystalline; chert, chalky white, doloclastic
- 4,327 Limestone, dolomitic, creamy white, coarsely crystalline; little chert, white with dull white spicular markings
- 4,359 Limestone, dolomitic, white very coarsely crystalline; much crystalline pyrite and glauconite
- 4,384 Limestone, slightly dolomitic, creamy white, coarsely crystalline; little chert, creamy white with spicular markings, and a few fragments of brown with white spicular markings

(11) B. M. SCOTT No. 1, TODD COUNTY

ZONE IV

- 1,233-1,240 Limestone, white, coarsely crystalline, crinoidal; some pyrite
- 1,270 Limestone, dolomitic, white, coarsely crystalline; chert dull mottled white, with dolocasts
- 1,285 Limestone, white crystalline, less cherty than above; much glauconite as bright green inclusions and bright stains on limestone
- 1,294 Limestone, white to gray, crystalline; little blue chert
- 1,300 Limestone, white, coarsely crystalline; chert white and translucent, some of which is banded with crystalline quartz; some glauconite
- 1,308 Limestone, white, coarsely crystalline as above but with no chert or glauconite
- 1,314 Limestone, white to gray, crystalline, some spotted with dark material; chert white and translucent, a little blue chert; fossiliferous; a little glauconite
- 1,336 Limestone, white to tan, finely crystalline; chert, translucent, some spicular and some showing banding with crystalline quartz
- 1,345 Limestone, tan, finely crystalline; chert, amber-like brown to blue transparent with dark flecks
- 1,373 Dolomite, brown, rhombs distinct, showing some porosity; chert brown, some chalky white with a few dolocasts, some translucent with fine spicular markings; little glauconite

ZONE V

- 1,383 Limestone, white, coarsely crystalline with some pink and green fragments; no chert
- 1,388 Limestone as above with introduction of a little more argillaceous and green

ZONE VI

- 1,390 Limestone, greenish gray, argillaceous, enclosing tan crinoid stem plates; pyrite crystals enclosed in limestone
- 1,409 Same kind of limestone as above, very fossiliferous with fragments of brachiopods, ostracodes, and crinoids; some glauconite

ZONE VII

- 1,414 Limestone, white and pink, coarsely crystalline, fossiliferous with much calcareous, orange-red shale
- 1,441 Limestone, white, finely crystalline, some tannish pink dolomite, very fossiliferous
- 1,463 Dolomite, very finely crystalline, gray with some coarsely crystalline white limestone and crinoid fragments; fragments of blue-white translucent chert
- 1,487 Limestone, gray, slightly argillaceous, crinoidal; chert opalescent; some glauconite

(15) HILLMAN No. 1, TRIGG COUNTY¹⁰

ZONE IV

- 830- 843 Limestone, dull gray, argillaceous; some blue chert and pyrite

¹⁰ (12) R. E. Lee No. 1, Muhlenberg County, drilled many years ago and a complete set of samples was not available.

(13) Clements No. 1, Hopkins County, rotary samples from which a detailed study of this kind could not be made.

(14) Hillman No. 2, Trigg County, similar to Hillman No. 1.

- 863 Limestone, white, crystalline; some brown chert and a little blue chert; pyritic shale and some glauconite
- 873 Limestone as above but chert is lighter in color and some is opalescent
- 900 Limestone, dolomitic, white, less cherty than above; chert is chalky white, dolocastic
- 905 Limestone, dolomitic, tan to white; little white chert, angular quartz grains
- 925 Limestone as above; tan chert; rare rounded and frosted sand grains; some glauconite
- 1,080 Dolomite, white crystalline; dull white dolocastic chert
- 1,160 Limestone, dolomitic; much light gray chert with finely disseminated pyrite; slightly glauconitic
- 1,170 Limestone, less dolomitic than above and more glauconite
- 1,225 Limestone, light tannish gray, crystalline, fossiliferous with no identifiable fossil; much pale blue aragonite; some glauconite
- 1,250 Limestone, dolomitic, white; little white chert
- 1,300 Limestone, light gray, crystalline, very fossiliferous with many fragments of brachiopods; chert, gray with texture of novaculite; glauconite
- 1,405 Limestone, dark gray with much dark blue-brown, translucent chert, some of which is flinty with conchoidal fracture
- 1,495 Limestone, dense to fine-grained, brown; chert lighter in color making up large part of sample; some glauconite
- 1,520 Limestone, white, crystalline, fossiliferous; some bright blue chert and glauconite
- 1,530 Limestone, tan; some blue chert and some light gray chert
- 1,535 Limestone as above; a few fragments of bentonite-like shale with large biotite inclusions

ZONE V

- 1,565 Limestone, light gray, crystalline; much chert, blue-white and translucent
- 1,570 Limestone, darker in color, and some of it is leached white; little bentonite-like shale

ZONE VI

- 1,600 Limestone, dark, argillaceous, showing some leaching
- 1,625 Limestone, dark gray-brown, finely crystalline, argillaceous

ZONE VII

- 1,655 Limestone, very coarsely crystalline, white, pink and green with some red argillaceous limestone
- 1,720 Limestone, darker red, some green; crystals of red calcite; all argillaceous
- 1,760 Limestone as above with introduction of a little green calcareous shale
- 1,795 Limestone, finely crystalline, light gray-green, argillaceous
- 1,800 Limestone with red calcite streaks
- 1,830 Limestone, red and white, argillaceous, some clear red calcite; some glauconite
- 1,835 Limestone, light gray, finely crystalline
- 1,870 Shale, gray, hard, coarse-textured, little fine sand; pyrite
- 1,900 Limestone, argillaceous, gray, fossiliferous

(16) PURVIS NO. 1, LOGAN COUNTY

ZONE II

- 1,468-1,475 Limestone, white, crystalline, fossiliferous, leached; some brown dolomite with oil staining
- 1,479 Limestone, white to light gray, crystalline; rare fragments of translucent blue-white chert
- 1,494 Limestone, white, coarsely crystalline, chalky
- 1,510 Limestone, white to cream, coarsely crystalline as above; some blue-white translucent, almost opalescent chert
- 1,517 Limestone, tan, crystalline, crinoidal
- 1,527 Limestone, tan, dense to finely crystalline; some brown slightly argillaceous limestone
- 1,540 Limestone, white to tan crystalline with brown amber-like chert with dark inclusions

ZONE III

- 1,545 Limestone, white to tan crystalline; little brown chert as above; some gray-white blocky chert; many rounded and frosted and grains enclosed in the limestone

ZONE IV

- 1,572 Limestone, dolomitic, light tan, some having leached appearance; much chert, dull to semi-translucent, doloclastic; little glauconite
- 1,588 Limestone, white to tan, with leached appearance; chert as above with addition of a few tan translucent fragments having white spicular markings; little glauconite
- 1,610 Dolomite, white to tan; much chert, translucent to dull with many dolocasts; much glauconite
- 1,615 Limestone, white, crystalline; some chert, blue-white translucent; little glauconite
- 1,632 Limestone, white, crystalline to gray with dark flecks; chert is blue-white translucent, but some is distinctly blue
- 1,653 Limestone, white, crystalline; chert rare and blue; few glauconite inclusions
- 1,661 Limestone, light gray, crystalline, some with dark flecks; some of chert has dark flecks and fine spicular markings
- 1,680 Limestone, dolomitic, white to light tan; much chert, some translucent tan and some dull with occasional dolocasts and faint spicular markings

(17) CORNIFEROUS TEST WELL, OHIO COUNTY¹¹

ZONE IV

- 2,038-2,041 Limestone, tan, finely crystalline, little argillaceous, few fragments of blue-white translucent chert
- 2,050 Limestone, slightly dolomitic, white to light tan, crystalline; chert, some mottled tan, some translucent, a little brown with white spicular markings
- 2,059 Limestone, white to tan, coarsely crystalline; very little chert, some of which is drusy
- 2,075 Limestone, tan, crystalline, some coarsely crystalline and crinoidal; little chalcedony in residue
- 2,087 Limestone, white to tan, coarsely crystalline, leached looking; little mottled tan chert
- 2,096 Limestone, tan, crystalline; about 30 per cent chert, mostly tan mottled, much is brown semi-translucent with dark flecks
- 2,105 Limestone, white, coarsely crystalline; no chert
- 2,121 Limestone, dolomitic; about 50 per cent chert, white, chalky, doloclastic, showing some spicular markings

ZONE V

- 2,145 Limestone, white, coarsely crystalline, some pink and green limestone; much pyrite

CONCLUSIONS

CORRELATION

On the basis of the zonal system introduced in this article, the correlation of the Devonian and subjacent Silurian formations of western Kentucky is as indicated in Figures 6 and 7. These correlations are necessarily tentative and will be subject to revision as new material becomes available.

The absence of the Decatur and upper Brownsport, Zones V and VI, from the sections high on the flank of the Cincinnati arch, and

¹¹ Located at junction of three farms: G. H. Roberts, G. E. Fuqua, and S. Lancaster Estate, near Fordsville.

their presence on the west side of the basin indicates some post-Middle Silurian and pre-Devonian uplift and erosion. It is suggested that this may be the evidence hitherto lacking for a reflection of the Caledonian mountain-building episode in the Mississippi Valley and Cincinnati arch areas.

The thickening of the Lower and lower Middle Devonian to the southwest suggests that the source of the thick cherts and dolomites was in that direction. The Kentucky strata may represent the seaward facies of the Arkansas and Texas novaculites.

Post-Hamilton warping of the basin, perhaps as a result of relative east-west uplift occasioned by movement of the Nashville dome, served to cut off the southern end of the syncline. This resulted in the preservation of a complete section of Lower and Middle Devonian strata in the deepest part, and the stripping of the Hamilton and most of the Onondaga from the east, south, and west sides. All or nearly all of the Devonian sediments were removed from the region high on the Cincinnati arch side of the basin before deposition of the Chattanooga shale.

RELATION TO PETROLEUM POSSIBILITIES

To date there have been no wells of commercial importance drilled which produce from the Devonian rocks of western Kentucky. This does not, however, rule out the possibility of the existence of oil and gas reservoirs. Lower and Middle Devonian strata in the area from which the Upper Devonian limestones have been eroded must have been subjected to dolomitization and recrystallization in many places with resultant horizons of potential reservoir rock. This must also apply to the Decatur limestone just west of the area of its complete removal, and also to the pre-Louisville limestones where the Louisville has been removed. Larue County gas production from the Laurel dolomite is an illustration of such a situation. The scarcity of data makes it possible to indicate only within wide limits the areas where exploratory work might be advisable.

BIBLIOGRAPHY

1. BASSETT, C. F., "The Devonian Strata of the Alto Pass Quadrangle, Illinois," *Trans. Illinois State Acad. Sci.*, Vol. 18 (1925), pp. 360-68.
2. BUTTS, CHARLES, "Geology of Jefferson County, Kentucky," *Kentucky Geol. Survey*, Ser. 4, Vol. 3, Pt. 2 (1915).
3. ———, "Geology of Barren County, Kentucky," *Mineral and Forest Resources of Kentucky*, Ser. 5, Vol. 2, No. 1 (1919), pp. 147-77.
4. ———, "The Appalachian Plateau and Mississippi Valley," *Geology of North America*, edited by Rudolf Ruedemann and Robert Balk for the series *Geologie der Erde*. Gebrüder Borntraeger, Berlin (1939).
5. COLLETT, JOHN, "Geology of Shelby County, Indiana," *Indiana Dept. Geol. and Nat. Resources 11th Ann. Rept.* (1882).

6. COX, E. T., *Eighth, Ninth and Tenth Annual Reports of the Geological Survey of Indiana, Made during the Years 1876, 1877 and 1878*. Indianapolis (1879). 542 pp.
7. CRONEIS, CAREY, and HOFFMAN, ARNOLD D., "The Fauna of the Middle Devonian Beauvais Sandstone of Missouri," *Science*, Vol. 73, No. 1883 (1931), pp. 134-35.
8. CUMINGS, E. R., "The Nomenclature and Description of the Geological Formations of Indiana: Part IV, Handbook of Indiana Geology," *Indiana Dept. Conservation Pub.* 21 (1922).
9. DAKE, C. L., "The Sand and Gravel Resources of Missouri," *Missouri Bur. Geol. and Mines*, 2nd Ser., Vol. 15 (1918).
10. DUNBAR, CARL O., "Stratigraphy and Correlation of the Devonian of Western Tennessee," *Amer. Jour. Sci.*, 4th Ser., Vol. 46 (1918), pp. 732-55.
11. ———, "Stratigraphy and Correlation of the Devonian of Western Tennessee," *Tennessee Geol. Survey Bull.* 21 (1919).
12. EATON, AMOS, "Cherty Lime Rock or Corniferous Lime Rock Proposed as the Line of Reference for State Geologists of New York and Pennsylvania," *Amer. Jour. Sci.*, Vol. 36 (1839).
13. FOERSTE, A. F., "Silurian and Devonian Limestones of Tennessee and Kentucky," *Bull. Geol. Soc. America*, Vol. 12 (1901), pp. 395-444.
14. ———, "Silurian and Devonian Limestones of Western Tennessee," *Jour. Geol.*, Vol. 11 (1903), pp. 554-83, 679-75.
15. ———, "Silurian Clays, with Notes on Clays of the Waverly and Irvine Formations (of Kentucky)," *Kentucky Geol. Survey Bull.* 6 (1905), pp. 143-78.
16. ———, "The Silurian, Devonian, and Irvine Formations of East-Central Kentucky, with an Account of Their Clays and Limestone," *ibid.*, *Bull.* 7 (1906).
17. KEYES, C. R., "Paleontology of Missouri," *Missouri Geol. Survey*, Vol. 4 (1894).
18. KINDLE, EDWARD M., "The Devonian and Lower Carboniferous Faunas of Southern Indiana and Central Kentucky," *Bull. Amer. Paleontologist*, Vol. 3, No. 12 (1899), p. 111.
19. ———, "The Devonian Fossils and Stratigraphy of Indiana," *Indiana Dept. Geol. and Nat. Resources Ann. Rept.* 25 (1901), pp. 529-758, 773-75.
20. ———, "The Unconformity at the Base of the Onondaga Limestone in New York and Its Equivalent West of Buffalo," *Jour. Geology*, Vol. 21 (1919), pp. 301-19.
21. LOGAN, W. N., "Outlines of Indiana Geology," *Pan-Amer. Geol.*, Vol. 40 (1923), pp. 111-39.
22. MILLER, ARTHUR M., "The Geology of Kentucky," *Kentucky Dept. Geol. and Forestry*, Ser. 5, *Bull.* 2 (1919).
23. ———, "Geology of Allen County, Kentucky," *ibid.*, Ser. 5, Vol. 1, No. 3 (1919).
24. POHL, ERWIN R., "Devonian Record in Central Tennessee," *Bull. Geol. Soc. America* (abstract), Vol. 41 (1930), p. 195.
25. ———, "Underground in Tennessee and Kentucky," *Tennessee Acad. Sci. Jour.*, Vol. 5, No. 3 (1930).
26. SAFFORD, J. M., and SCHUCHERT, CHARLES, "The Camden Chert of Tennessee and Its Lower Oriskany Fauna," *Amer. Jour. Sci.*, 4th Ser., Vol. 7 (1899), pp. 429-32.
27. SAVAGE, THOMAS EDMUND, "The Grand Tower (Onondaga) Formation of Illinois, and Its Relation to the Jeffersonville Beds of Indiana," *Illinois Acad. Sci. Trans.*, Vol. 3 (1910), pp. 116-32.
28. ———, "The Devonian Formations of Illinois," *Amer. Jour. Sci.*, 4th Ser., Vol. 49 (1920), pp. 169-82.
29. ———, "Comparison of the Devonian Rocks of Illinois and Missouri," *Jour. Geol.*, Vol. 33 (1925), pp. 550-58.
30. ———, "Oriskany Rocks of Illinois," *Amer. Jour. Sci.*, 5th Ser., Vol. 10 (1925), pp. 139-44.
31. ———, "Devonian Rocks of Kentucky," *Kentucky Geol. Survey*, Ser. 6, Vol. 33 (1930), pp. 1-161.
32. SHAW, EUGENE W., and MATHER, KIRTLEY F., "The Oil Fields of Allen County, Kentucky," *U. S. Geol. Survey Bull.* 688 (1919).
33. SIEBENTHAL, CLAUDE E., "The Silver Creek Hydraulic Limestone of Southeastern Indiana," *Indiana Dept. Geol. and Nat. Resources Ann. Rept.* 25 (1901), pp. 331-89.
34. SUTTON, D. G., and SUTTON, A. H., "Middle Devonian of Southern Indiana," *Jour. Geol.*, Vol. 45 (1937), pp. 320-31.
35. ULRICH, E. O., quoted by E. R. Buckley and H. A. Buehler, "The Quarrying Industry in Missouri," *Missouri Bur. Geol. and Mines*, 2nd Ser., Vol. 2 (1904), p. 110.

36. United States Geological Survey, "Lexicon of Geologic Names of the United States," *Bull. 896*, Pt. 1 (1938), p. 458.
37. WELLER, J. MARVIN, "Devonian System," *Guide Book Thirteenth Ann. Field Conference Kansas Geol. Soc.* (1939), pp. 127-30.
38. WELLER, STUART, and ST. CLAIR, STUART, "Geology of Ste. Genevieve County, Missouri," *Missouri Bur. Geol. and Mines*, 2nd Ser., Vol. 22 (1928).
39. WILSON, MORLEY E., "The Occurrence of Oil and Gas in Missouri," *ibid.*, Vol. 16 (1922).
40. WORKMAN, L. E., "Subsurface Geology of the Devonian System in Illinois." Paper read before the Twenty-fifth Annual Meeting of the American Association of Petroleum Geologists, Chicago, April 11, 1940.
41. WORTHEN, AMOS HENRY, "Geology of Illinois: Devonian and Silurian Systems," *Illinois Geol. Survey*, Vol. 1 (1866).

